# Government College of Engineering, Karad

(*an Autonomous Institute of Government of Maharashtra*)

## Scheme of Instructions and Syllabus

Scheme of Instructions for First Year M. Tech. course in Design Engineering

Semester – I (w.e.f.: AY 2019-20)

| Sr. | Course Category | Course Code | Course Title | L | T | P | Contact Hrs / week | Credits | Exam Scheme | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | CT - 1 | CT - 2 | TA / CA | ESE | TOTAL |
| 1. | PCC | DE1101 | Vibrations and Acoustics | 3 | - | - | 3 | 3 | 15 | 15 | 10 | 60 | 100 |
| 2. | PCC | DE1102 | Stress Analysis | 3 | - | - | 3 | 3 | 15 | 15 | 10 | 60 | 100 |
| 3. | PEC | DE11*3 | Program Elective - I | 3 | - | - | 3 | 3 | 15 | 15 | 10 | 60 | 100 |
| 4. | PEC | DE11*4 | Program Elective - II | 3 | - | - | 3 | 3 | 15 | 15 | 10 | 60 | 100 |
| 5. | MDC | RM1105 | Research Methodology | 2 | - | - | 2 | 2 | 15 | 15 | 10 | 60 | 100 |
| 6. | PCC | DE1106 | Lab Practice - I | - | - | 4 | 4 | 2 | - | - | 25 | 25 | 50 |
| 7. | PEC | DE1107 | Lab Practice- II | - | - | 4 | 4 | 2 | - | - | 25 | 25 | 50 |
| 8. | OEC | OE11*8 | Open Elective | 3 | - | - | 3 | 3 | 15 | 15 | 10 | 60 | 100 |
| 9. | MNC | AU11*9 | Audit Course - I | 2 | - | - | 2 | - | - | - | - | - | - |
| | | | **Total** | 19 | - | 8 | 27 | 21 | 90 | 90 | 110 | 410 | 700 |

L- Lecture T-Tutorial P-Practical CT1- Class Test 1 CT2- Class Test 2 TA/CA- Teacher Assessment / Continuous Assessment

ESE- End Semester Examination (For Laboratory: End Semester Performance)

*- Program Elective / Audit Course / Open Elective (*list is provided at the end of structure*)

# Government College of Engineering, Karad

(*an Autonomous Institute of Government of Maharashtra*) **Scheme**

**of Instructions and Syllabus**

Scheme of Instructions for First Year M. Tech. course in Design Engineering

Semester – II (w.e.f.: AY 2019- 2020)

| Sr. | Course Category | Course Code | Course Title | L | T | P | Contact Hrs / week | Credits | Exam Scheme | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | CT - 1 | CT - 2 | TA / CA | ESE | TOTAL |
| 1. | PCC | DE1201 | Finite Element Analysis | 3 | - | - | 3 | 3 | 15 | 15 | 10 | 60 | 100 |
| 2. | PCC | DE1202 | Computer Aided Design | 3 | - | - | 3 | 3 | 15 | 15 | 10 | 60 | 100 |
| 3. | PEC | DE12*3 | Program Elective - III | 3 | - | - | 3 | 3 | 15 | 15 | 10 | 60 | 100 |
| 4. | PEC | DE12*4 | Program Elective – IV | 3 | - | - | 3 | 3 | 15 | 15 | 10 | 60 | 100 |
| 5. | PEC | DE12*5 | Program Elective - V | 3 | - | - | 3 | 3 | 15 | 15 | 10 | 60 | 100 |
| 6. | PCC | DE1206 | Lab Practice - III | - | - | 4 | 4 | 2 | - | - | 25 | 25 | 50 |
| 7. | PEC | DE1207 | Lab Practice - IV | - | - | 4 | 4 | 2 | - | - | 25 | 25 | 50 |
| 8. | P / S/ IT | DE1208 | Seminar on Pre-Dissertation work | - | - | 4 | 4 | 2 | - | - | 50 | 50 | 100 |
| 9. | MNC | AU12*9 | Audit Course – II | 2 | - | - | 2 | - | - | - | - | - | - |
| | | | **Total** | 17 | - | 12 | 29 | 21 | 90 | 90 | 110 | 410 | 700 |

L- Lecture T-Tutorial P-Practical CT1- Class Test 1 CT2- Class Test 2 TA/CA- Teacher Assessment / Continuous Assessment

ESE- End Semester Examination (For Laboratory: End Semester Performance)

*- Program Elective / Audit Course / Open Elective (*list is provided at the end of structure*)

# Government College of Engineering, Karad

(*an Autonomous Institute of Government of Maharashtra*)

## Scheme of Instructions and Syllabus

Scheme of Instructions for First Year M. Tech. course in Design Engineering

Semester – III (w.e.f.: AY 2019-20)

| Sr. | Course Category | Course Code | Course Title | L | T | P | Contact Hrs / week | Credits | Exam Scheme | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | CT - 1 | CT - 2 | TA / CA | ESE | TOTAL |
| 1. | P / S / IT | DE1301 | Dissertation - I | - | - | 20 | 20 | 7 | - | - | 100 | 100 | 200 |
| 2. | PEC | DE 1302 | Online Course (8-12 Week) | - | - | - | - | 3 | - | - | - | - | - |
| | | | **Total** | - | - | 20 | 20 | 10 | - | - | 100 | 100 | 200 |

TA/CA- Teacher Assessment / Continuous Assessment

ESE- End Semester Examination (For Laboratory: End Semester Performance)

Note:

1. DE1302 will be decided by respective Guide in Consultation with Program Coordinator. Course is mandatory is for student

2. In Case, the course offered online are not completely relevant with the topic of dissertation then any course suggested by NASSCOM on recent technologies can be opted by candidate.

# Government College of Engineering, Karad

(*an Autonomous Institute of Government of Maharashtra*)

## Scheme of Instructions and Syllabus

Scheme of Instructions for First Year M. Tech. course in Design Engineering

Semester –IV (w.e.f.: AY 2019-20)

| Sr. | Course Category | Course Code | Course Title | L | T | P | Contact Hrs / week | Credits | Exam Scheme | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | CT - 1 | CT - 2 | TA / CA | ESE | TOTAL |
| 1. | P / S / IT | DE1401 | Dissertation - II | - | - | 32 | 32 | 16 | - | - | 100 | 200 | 300 |
| | | | **Total** | - | - | 32 | 32 | 16 | - | - | 100 | 200 | 300 |

TA/CA- Teacher Assessment / Continuous Assessment

ESE- End Semester Examination (For Laboratory: End Semester Performance)

# Government College of Engineering, Karad

(*an Autonomous Institute of Government of Maharashtra*)

## Scheme of Instructions and Syllabus

Scheme of Instructions for First Year M. Tech. course in Production Engineering

## List of Program Elective Courses

| **Semester - I** | | | **Semester - II** | | |
|---|---|---|---|---|---|
| **Program Elective - I** | **Program Elective - II** | | **Program Elective - III** | **Program Elective - VI** | **Program Elective - V** |
| **DE1113:** Advanced Mathematical Methods in Mechanical Design | **DE1114:** Advanced Machine Design | | **DE1213:** Mechatronics and Control Systems | **DE1214:** Nonlinear and Random Vibrations | **DE1215:** Optimization Techniques |
| **DE1123:** Experimental Stress Analysis | **DE1124:** Fatigue, Fracture and Failure Analysis | | **DE1223:** Mechanisms and Robotics | **DE1124:** Condition Monitoring | **DE1225:** Materials and Composites |
| **DE1133:** Mathematical Methods for Mechanics and Dynamics | **DE1134:** Tribology | | **DE1233:** Rapid Prototyping & 3D Printing | **DE1234:** Synthesis of Mechanisms | **DE1235:** Automotive System Design |
| **DE1143:** Reliability Engineering | **DE1144:** MEMS and Nanotechnology | | **DE1243:** Internet of Things & Machine Learning | **DE1244:** Vehicle Dynamics | **DE1245:** Industrial Product Design |

# List of Open Electives and Audit Courses

| Semester - I | | | Semester - II |
|---|---|---|---|
| **Open Electives** | **Audit Course - I** | | **Audit Course - II** |
| **OE1118:** Business Analytics | **AU1119:** Research Paper Writing | | **AU1219:** Constitution of India |
| **OE1128:** Industrial Safety | **AU1129:** Disaster Management | | **AU1229:** Pedagogy Studies |
| **OE1138:** Operation Research | **AU1139:** Sanskrit for Technical Knowledge | | **AU1239:** Stress Management by Yoga |
| **OE1148:** Cost Management of Engineering Projects | **AU1149:** Value Education | | **AU1249:** Personality Development through Life Enlightenment Skills |
| **OE1158:** Composite Materials | | | |
| **OE1168:** Waste to Energy | | | |

## Government College of Engineering, Karad

## M Tech-First Year (Sem – I) Design Engineering

## DE1101: Vibrations and Acoustics

| Teaching Scheme | | | Examination Scheme | |
|---|---|---|---|---|
| Lectures | 03 Hrs/week | | CT – 1 | 15 |
| Tutorials | 00 Hrs/week | | CT – 2 | 15 |
| Total Credits | 03 | | TA | 10 |
| | | | ESE | 60 |
| | | | Duration of ESE | 02 Hrs 30 Min |

**Course Outcomes (CO)**

| | |
|---|---|
| **1.** | The students will be able to model a given vibratory system as SDOF or MDOF system, with or without damping, free and forced. Further they shall understand a self-excited systems, isolations, force transmissibility |
| **2.** | The students will be able to derive differential equations of motion for MDOF systems and solve using classical methods as well as numerical methods using suitable software. |
| **3.** | The students will be able to derive and solve continuous vibratory systems such as bar, beam etc. |
| **4.** | The students will understand use of accelerometer, noise sensors and FFT analysers and its algorithm |

| | Course Contents | Hours |
|---|---|---|
| **Unit 1** | **Basic Introduction:** Free vibration equation of motion, influence coefficient i) stiffness coefficient (ii) flexibility coefficient generalized coordinates, coordinate couplings, Lagrange's equations matrix method Eigen values Eigen vector problems, modal analysis, forced vibrations of undamped system and modal analysis, | **( 7 )** |
| **Unit 2** | **Distributed-Parameter Systems,** Transverse Vibration of Strings / Derivation of the String Vibration Problem by the Extended Hamilton Principle / Bending Vibration of Beams / Free Vibration. The Differential Eigenvalue Problem / Orthogonality of Modes, Lumping / Lumped-Parameter Method Using Influence Coefficients,<br>**Numerical methods** - (i) Rayleigh's Method, (ii) Rayleigh-Ritz Method (iii) Holzer's Method (iv) Methods of Matrix iterations (v) Transfer Matrix Method, impulse response and frequency response functions. | **( 7 )** |
| **Unit 3** | **Condition Monitoring:** FFT analyzer, vibration exciters, signal analysis, time domain and frequency domain analysis of signals, experimental modal analysis, machine conditioning and monitoring, fault diagnosis Vibration Measuring devices, Accelerometers, Impact hammer, Vibration shaker- construction, principles of operation and uses, Vibration Analyzer, Signal analysis - Analysis of Vibration Spectrum, Standards related to measurement of vibration, Machine Conditioning and Monitoring, fault diagnosis | **( 7 )** |
| **Unit 4** | **Vibration Instrumentations:** Vibration Measuring devices, Accelerometers, Impact hammer, Vibration shaker- construction, principles of operation and uses, Vibration Analyzer, Signal analysis - Analysis of Vibration Spectrum, Standards related to measurement of vibration, Machine Conditioning and Monitoring, fault diagnosis | **( 7 )** |
| **Unit 5** | **Noise:** Fundamentals of noise Sound concepts, Decibel Level, White noise, Weighted sound pressure level, Logarithmic addition, Subtraction and averaging, Sound intensity, Noise measurement, Sound fields, Octave band, Sound reflection, Absorption and transmission, Passby-noise, Reverberation chamber, Anechoic Chamber, Noise standards | **( 7 )** |
| **Unit 6** | **Nonlinear vibrations:** Sources of nonlinearity, Qualitative and Quantitative Analysis Methods, Duffings Equation, The van der Pol Oscillator / The Fundamental Perturbation Technique, Jump Phenomenon / Subharmonics and Combination Harmonics / Systems with Time-Dependent Coefficients. | **( 5 )** |

**Tutorials**

| | |
|---|---|
| 1. | Formulation / Derivation of equation of motion on practical systems such as suspension system, engine mount etc. |

| | |
|---|---|
| 2. | MATLAB simulation of single DoF system, damped, undamped, Free and Forced vibrations |
| 3. | MATLAB simulation of Multi-DoF system using numerical methods |
| 4. | Assignment on FFT Analyzer |
| 5. | Assignment on Noise Analysis |
| 6 | Assignment on Nonlinear Vibrations |
| **Text Books** | |
| **1.** | Mechanical Vibrations – G.K. Grover (TMH- Sigma Series, 2008) |
| **2.** | S.S. Rao, Addison, "Mechanical Vibrations", Wesley Publishing Co., 1990. |
| **3.** | Fundamentals of Vibration, Leonard Meirovitch, McGraw Hill International Edison |
| **Reference Books** | |
| **1.** | Mechanical Vibrations, J P Den Hartog, McGraw Hill |
| **2.** | Mechanical Vibrations, Austin Church, Wiely Eastern, 2nd Edition |
| **3.** | Mechanical Vibrations, J.P. Den Hartong, Tata Mc-Graw Hill Book, 3rd Edition, 2008 |
| **4.** | Vibrations and Noise for Engineers, Kewal Pujara Dhanpat Rai and Sons, 4th Edition, 2007. |
| **Useful Links** | |
| **1.** | http://nptel.iitm.ac.in |

## Mapping of COs and Pos

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 6 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 2 | 1 | 3 | 1 | | 2 | 3 | 1 | 2 | | 3 | 3 | 3 | 2 | |
| CO 2 | | | | 1 | | | 2 | 1 | 1 | | | | | | 2 |
| CO 3 | | 2 | | 3 | | 2 | | | | | | 1 | 2 | | 1 |
| CO 4 | | | 1 | 1 | 1 | 2 | | 2 | 2 | 3 | | | | 3 | |
| CO 5 | 1 | | 2 | | 2 | 2 | 2 | 3 | | 2 | 2 | 3 | 2 | 1 | 2 |

## Assessment Pattern **(with revised Bloom's Taxonomy)**

| Knowledge Level | CT 1 | CT 2 | TA | ESE |
|---|---|---|---|---|
| Remember | 3 | 3 | 1 | 10 |
| Understand | 3 | 3 | 2 | 10 |
| Apply | 3 | 3 | 2 | 10 |
| Analyse | 2 | 2 | 2 | 10 |
| Evaluate | 2 | 2 | 2 | 10 |
| Create | 2 | 2 | 1 | 10 |
| TOTAL | 15 | 15 | 10 | 60 |

# Government College of Engineering, Karad

## M Tech-First Year (Sem – I) Design Engineering

## DE1102: Stress Analysis

| Teaching Scheme | | | Examination Scheme | |
|---|---|---|---|---|
| Lectures | 03 Hrs/week | | CT – 1 | 15 |
| Tutorials | | | CT – 2 | 15 |
| Total Credits | 03 | | TA | 10 |
| | | | ESE | 60 |
| | | | Duration of ESE | 02 Hrs 30 Min |

**Course Outcomes (CO)**

| | |
|---|---|
| **1.** | Students will understand the tensorial approach of continuum mechanics and comprehend modern research material. |
| **2.** | Student will learn basic field equations such as equilibrium equations, compatibility and constitutive relationship. |
| **3.** | Students will be able to apply basic field equations to torsion, bending and two dimensional problems, energy methods and plastic hinges. |
| **4.** | Students will be proficient in using FEM software packages with framing correct boundary conditions. |
| **5.** | |

| | Course Contents | Hours |
|---|---|---|
| **Unit 1** | **Continuum & Tensors:** Stress tensor, Differential equations of equilibrium, Boundary conditions, Stress functions and Bi-harmonic equation | **(06)** |
| **Unit 2** | Displacement and strains, compatibility, | **(06)** |
| **Unit 3** | Conservation Laws, Constitutive relations and Linear Elasticity, | **(06)** |
| **Unit 4** | **Two dimensional problems:**<br>Rectangular coordinates and polar coordinates , Applications to polynomials in rectangular coordinates, Saint-Venant's principle, General equations in polar coordinates,Strain components in polar coordinates,<br>Torsion: Torsion of bars with elliptical square and rectangular cross section Membrane analogy, Hydro dynamical analogy, Torsion of hollow and thin tubes,<br>Bending: Bending of Beams,pure bending of curved bars, Rotating discs, stresses in a circular , Energy methods,<br>Shear centre: Shear stress distribution and shear centre for thin walled open sections. | **(08)** |
| **Unit 5** | **Plasticity in structures**:<br>Introduction to elastic stability, Plasticity | **(06)** |
| **Unit 6** | **Thick cylinders and Disks, Contact stresses**<br>Shells and vessels of uniform strength, Problem of determining contact stresses, Assumption Expressions for principal stresses, Examples. | **(07)** |
| **Tutorials** | | |
| | | |

**Text Books**

| | |
|---|---|
| **1.** | Sadd, Martin H., Elasticity: Theory, applications and Numerics, Academic Press 2005 |
| **2.** | Boresi, A.P. and K. P. Chong, Elasticity in Engineering Mechanics, Second Edition, John Wiley & Sons, 2000 |
| **3.** | Budynas, R. G. Advance strength and Applied Stress Analysis, Second Edition, WCB/ McGraw Hill 1999 |

**Reference Books**

| | |
|---|---|
| **1.** | Popov, E.P., "Engineering Mechanics of Solids", 2nd Ed., Prentice Hall India,1998. |
| **2.** | S. Timoshenko and J.W. Goodier "Theory of Elasticity" MGH book coLtd |
| **3.** | Chakrabarty, "Theory of Plasticity", McGraw-Hill Book Company, New York1990. |
| **4.** | Sadhu Singh – Theory of Elasticity, Khanna Publisher. |

**Mapping of COs and POs**

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 6 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 1 | 3 | 2 | 3 | | 3 | 3 | 3 | 3 | | 3 | 2 | 2 | 2 | |
| CO 2 | | | | 2 | | | 3 | 1 | 3 | | | | | | 2 |
| CO 3 | | 3 | | 2 | | 3 | 1 | | | | | 1 | 1 | | 2 |
| CO 4 | | | 1 | 3 | 3 | 2 | 3 | 3 | 1 | 2 | | | | 3 | |
| | 1 | | 2 | | 2 | 2 | 3 | 2 | | 1 | 2 | 1 | 2 | 3 | 3 |

**Assessment Pattern(with revised Bloom's Taxonomy)**

| Knowledge Level | CT 1 | CT 2 | TA | ESE |
|---|---|---|---|---|
| Remember | 3 | 3 | 1 | 10 |
| Understand | 2 | 2 | 2 | 10 |
| Apply | 2 | 2 | 3 | 10 |
| Analyse | 3 | 2 | 3 | 10 |
| Evaluate | 3 | 3 | 1 | 10 |
| Create | 2 | 3 | 3 | 10 |
| TOTAL | 15 | 15 | 10 | 60 |

## Government College of Engineering, Karad

## M Tech-First Year (Sem – I) Design Engineering

## DE1143: Reliability Engineering

| Teaching Scheme | | | Examination Scheme | |
|---|---|---|---|---|
| Lectures | 03 Hrs/week | | CT – 1 | 15 |
| Tutorials | 00 Hrs/week | | CT – 2 | 15 |
| Total Credits | 03 | | TA | 10 |
| | | | ESE | 60 |
| | | | Duration of ESE | 02 Hrs 30 Min |

**Course Outcomes (CO)**

| | |
|---|---|
| **1.** | To prepare the students to succeed as designer in industry/technical profession. |
| **2.** | To provide student knowledge of reliability and maintainability of machines and systems. |
| **3.** | To train the students to apply knowledge of probability for reliability analysis of machines and mechanisms. |
| **4.** | To prepare the students to use reliability theory for product life calculation and for maintenance of machines and mechanical systems. |

| | Course Contents | Hours |
|---|---|---|
| **Unit 1** | **Module 1:**<br>Introduction, History, definition, application of reliability, Reliability function R(t), Probability density distribution function f(t) , Cumulative probability distribution function F(t), Hazard rate function Z(t), Mean time to failure, Mean time between failures. | **( 7 )** |
| **Unit 2** | **Module 2:**<br>Brief revision of probability mathematics, Relation between R(t), f(t), F(t), Z(t) etc. , Hazard rate models, Life cycle of the product, Bath tub curve, Failure analysis for discrete data | **( 7 )** |
| **Unit 3** | **Module 3:**<br>Probability distribution used in reliability, Exponential, Rayleigh, Normal, Binomial, Weibull distribution, Calculation of R(t), Z(t), MTTF for above distributions, identifying failure distributions, Probability plots, Least square curve fitting methods | **( 7 )** |
| **Unit 4** | **Module 4:**<br>Failure mode analysis, fault three and success three methods, symbols used, tie sets, cut sets, failure mode effectiveness and criticality analysis. | **( 7 )** |
| **Unit 5** | **Module 5:**<br>Reliability of the systems- series, parallel and redundancy (active, standby) systems, mixed , complex systems. | **( 7 )** |
| **Unit 6** | **Module 6:**<br>Introduction to maintainability-MTTR, Availability, Reliability design of elements, strength and duty distribution, factor of safety, simples examples of design of elements with reliability such as tension element, I beam, shaft subjected to torsion etc.<br>Reliability testing-product testing, life testing, bum in testing, acceptance testing, accelerated life testing, reliability growth. | **( 5 )** |

**Text Books**


| | |
|---|---|
| **1.** | Birolini, Alessandro, "*Reliability Engineering",* Springer, Fourth Edition, 2004. |
| **2.** | Modarres M, KaminskiyM, "*Reliability Engineering and Risk Analysis-A Practical Guide",* CRC Press, Second Edition, 2010. |

| Reference Books | | | |
|---|---|---|---|
| **1.** | Chrles E. Ebiting, "*Introduction to Reliability, Maintainability Engineering*", Tata McGraw Hills Pvt Ltd.,1980. | | |
| **2.** | K.C. Kapoor, L.R. Laimberson, "*Reliability in Engineering Design*", John Wiley & sons,1977. | | |
| **3.** | S.S.Rao, "*Reliability Based Design*", Tata McGraw Hills, 1st edition, 1980. | | |

## Mapping of COs and POs

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 6 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 3 | 3 | 2 | 1 | | 2 | 2 | 1 | 2 | | 3 | 3 | 3 | 3 | |
| CO 2 | 2 | | | 3 | 3 | | 2 | 3 | 2 | | | | | | 2 |
| CO 3 | | 1 | | 3 | | 3 | 3 | | | | | 1 | 3 | | 1 |
| CO 4 | | | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 3 | | | | 2 | |
| CO 5 | 3 | | 2 | | 2 | 2 | 3 | 1 | | 2 | 2 | 3 | 1 | 2 | 2 |

## Assessment Pattern **(with revised Bloom's Taxonomy)**

| Knowledge Level | CT 1 | CT 2 | TA | ESE |
|---|---|---|---|---|
| Remember | 3 | 3 | 1 | 10 |
| Understand | 3 | 2 | 2 | 10 |
| Apply | 2 | 3 | 2 | 10 |
| Analyse | 2 | 2 | 2 | 10 |
| Evaluate | 3 | 3 | 2 | 10 |
| Create | 2 | 2 | 1 | 10 |
| TOTAL | 15 | 15 | 10 | 60 |

## Government College of Engineering, Karad

## M Tech-First Year (Sem – I) Design Engineering

## DE1134: Tribology

| Teaching Scheme | | | Examination Scheme | |
|---|---|---|---|---|
| Lectures | 03 Hrs/week | | CT – 1 | 15 |
| Tutorials | | | CT – 2 | 15 |
| Total Credits | 03 | | TA | 10 |
| | | | ESE | 60 |
| | | | Duration of ESE | 02 Hrs 30 Min |

**Course Outcomes (CO)**

| | |
|---|---|
| **1.** | The students will be able to apply theories of friction and wear to various practical situations by analysing the physics of the process. |
| **2.** | They will understand the various surface measurement techniques and effect of surface texture on Tribological behaviour of a surface. |
| **3.** | They will be able to select materials and lubricants to suggest a tribological solution to a particular situation. |
| **4.** | The students will be able to design a hydrodynamic bearing using various bearing charts. |
| **5.** | The students will be able to understand the recent developments in the field and understand modern research material. |

| | Course Contents | Hours |
|---|---|---|
| **Unit 1** | Friction, theories of friction, Friction control, Surface texture and measurement, genesis of friction, instabilities and stick-slip motion. | **(06)** |
| **Unit 2** | Wear, types of wear, theories of wear, wear prevention. | **(06)** |
| **Unit 3** | Tribological properties of bearing materials and lubricants. | **(06)** |
| **Unit 4** | Lubrication, Reynold's equation and its limitations, idealized bearings, infinitely long plane pivoted and fixed show sliders, infinitely long and infinitely short (narrow) journal bearings, lightly loaded infinitely long journal bearing (Petroff's solution), Finite Bearings, Design of hydrodynamic journal bearings | **(06)** |
| **Unit 5** | Hydrostatic, squeeze film Circular and rectangular flat plates, variable and alternating loads, piston pin lubrications, application to journal bearings. | **(06)** |
| **Unit 6** | Elasto-hydrodynamic lubrication – pressure viscosity term in Reynolds's equation, Hertz' theory, Ertel-Grubin equation, lubrication of spheres, gear teeth and rolling element bearings, Air lubricated bearings, Tilting pad bearings, | **(06)** |

**Text Books**


| | |
|---|---|
| **1.** | Cameron, "Basic Lubrication Theory", Ellis Horwood Ltd, 1981. |
| **2.** | Principles in Tribology, Edited by J. Halling, 1975 |
| **3.** | Fundamentals of Fluid Film Lubrication – B. J. Hamrock, McGraw Hill International,1994 |
| **4** | D.D. Fuller, "Theory and Practice of Lubrication for Engineers", John Wiley and Sons, 1984. |


**Reference Books**


| | |
|---|---|
| **1.** | "Fundamentals of Friction and wear of Materials" American Society of Metals. |
| **2.** | Introduction to Tribology of Bearings –B. C. Majumdar, A. H. Wheeler & co. pvt. ltd 1985. |
| **3.** | T.A. Stolarski, "Tribology in Machine Design". |

## Mapping of COs and POs

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 6 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 3 | 2 | 1 | 3 | | 2 | 2 | 2 | 3 | | 3 | 3 | 3 | 2 | |
| CO 2 | 2 | | | 3 | 2 | | 2 | 3 | 3 | | | | | | 3 |
| CO 3 | 3 | 3 | | 1 | | 2 | 2 | | | | | 3 | 3 | | 1 |
| CO 4 | 2 | | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 3 | | | | 1 | |
| CO 5 | | | 3 | | 2 | 1 | 3 | 1 | | 3 | 2 | 1 | 3 | 2 | 1 |

## Assessment Pattern (with revised Bloom's Taxonomy)

| Knowledge Level | CT 1 | CT 2 | TA | ESE |
|---|---|---|---|---|
| Remember | 3 | 3 | 1 | 10 |
| Understand | 3 | 2 | 2 | 10 |
| Apply | 2 | 3 | 2 | 10 |
| Analyze | 2 | 2 | 2 | 10 |
| Evaluate | 3 | 3 | 2 | 10 |
| Create | 2 | 2 | 1 | 10 |
| TOTAL | 15 | 15 | 10 | 60 |

## Government College of Engineering, Karad

## M Tech-First Year (Sem – I) Design Engineering

## RM 1105: Research Methodology

| Teaching Scheme | | | Examination Scheme | |
|---|---|---|---|---|
| Lectures | 02 Hrs/week | | CT – 1 | 15 |
| Tutorials | 00 Hrs/week | | CT – 2 | 15 |
| Total Credits | 02 | | TA | 10 |
| | | | ESE | 60 |
| | | | Duration of ESE | 02 Hrs 30 Min |

**Course Outcomes (CO)**

| | |
|---|---|
| **1.** | The students will be able attend Research Problem |
| **2.** | The students will be able to handle data analysis and experimental instrumentations |
| **3.** | The students will be able to carry out modelling and performance prediction of linear and nonlinear models |
| **4.** | The students will be able to develop a research proposal |

| | Course Contents | Hours |
|---|---|---|
| **Unit 1** | **Research Problem**<br>Meaning of research problem, Sources of research problem, Criteria / Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem | **( 7 )** |
| **Unit 2** | **Basic instrumentation**<br>Instrumentation schemes, Static and dynamic characteristics of instruments used in experimental set up, Performance under flow or motion conditions, Data collection using a digital computer system, Linear scaling for receiver and fidelity of instrument, Role of DSP is collected data contains noise. | **( 7 )** |
| **Unit 3** | **Applied statistics**<br>Regression analysis, Parameter estimation, Multivariate statistics, Principal component analysis, Moments and response curve methods, State vector machines and uncertainty analysis, Probable errors in the research, Error analysis | **( 7 )** |
| **Unit 4** | **Data Analysis:** Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis – Cross tabulations and Chi-square test including testing hypothesis of association. | **( 7 )** |
| **Unit 5** | **Modelling and prediction of performance**<br>Setting up a computing model to predict performance of experimental system, Multi-scale modelling and verifying performance of process system, Nonlinear analysis of system and asymptotic analysis, Verifying if assumptions hold true for a given apparatus setup, Plotting family of performance curves to study trends and tendencies, Sensitivity theory and applications. | **( 7 )** |
| **Unit 6** | **Developing a Research Proposal**<br>Format of research proposal, Individual research proposal, Institutional proposal, Proposal of a student – a presentation and assessment by a review committee consisting of Guide and external expert only, Other faculty members may attend and give suggestions relevant to topic of research. | **( 5 )** |

**Tutorials**

| | |
|---|---|
| 1. | Assignment on |
| 2. | MATLAB simulation on Data Analysis |

| | |
|---|---|
| 3. | MATLAB simulation on DOE analysis |
| 4. | Assignment on preparation of Research Proposal |
| 5. | Assignment on statistics |
| 6 | Assignment on Modeling and Prediction |
| **Text Books** | |
| **1.** | 'Research methodology: an introduction for science & engineering students', by Stuart Melville and Wayne Goddard |
| **2.** | 'Research Methodology: An Introduction' by Wayne Goddard and Stuart Melville |
| **3.** | 'Research Methodology: A Step by Step Guide for Beginners', by Ranjit Kumar, 2nd Edition |
| **Reference Books** | |
| **1.** | 'Research Methodology: Methods and Trends', by Dr. C. R. Kothari |
| **2.** | 'Operational Research' by Dr. S.D. Sharma, Kedar Nath Ram Nath & co. |
| **Useful Links** | |
| **1.** | http://nptel.iitm.ac.in |

## Mapping of COs and POs

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 6 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 3 | 3 | 3 | 2 | | 1 | 3 | 3 | 3 | | 2 | 3 | 3 | 3 | |
| CO 2 | 1 | | | 3 | 2 | | 3 | 3 | 1 | | | | | 3 | 3 |
| CO 3 | 3 | 1 | | 2 | | 3 | 2 | | | | | 1 | 3 | | 3 |
| CO 4 | 2 | | 2 | 2 | 2 | 1 | 3 | 3 | 3 | 1 | | | | 2 | |
| CO 5 | | | 3 | | 3 | 3 | 1 | 1 | | 1 | 1 | 3 | 2 | 2 | 1 |

## Assessment Pattern(with revised Bloom's Taxonomy)

| Knowledge Level | CT 1 | CT 2 | TA | ESE |
|---|---|---|---|---|
| Remember | 3 | 3 | 1 | 10 |
| Understand | 3 | 3 | 2 | 10 |
| Apply | 3 | 3 | 2 | 10 |
| Analyse | 2 | 2 | 2 | 10 |
| Evaluate | 2 | 2 | 2 | 10 |
| Create | 2 | 2 | 1 | 10 |
| TOTAL | 15 | 15 | 10 | 60 |

| Government College of Engineering, Karad | | | | |
|---|---|---|---|---|
| M Tech-First Year (Sem – I) Design Engineering | | | | |
| DE1106: Lab Practice - I | | | | |
| **Teaching Scheme** | | | **Examination Scheme** | |
| Practical | 04 Hrs/week | | CT – 1 | 00 |
| Tutorials | 00 Hrs/week | | CT – 2 | 00 |
| Total Credits | 02 | | TA | 25 |
| | | | ESE | 25 |
| | | | Duration of ESE | 02 Hrs 30 Min |

| **Course Outcomes (CO)** | |
|---|---|
| **1.** | The students will be able to measure experimentally principal strain and stresses using strain gauges |
| **2.** | The students will be able to measure experimentally vibration signals and carry out FFT analysis |
| **3.** | The students will be able to measure experimentally conduct condition monitoring and fault diagnosis of machine component using FFT and Noise signal analysis |
| **4.** | The students will be able to measure experimentally conduct modal analysis using vibration shaker |

| | **Course Contents** | **Hours** |
|---|---|---|
| **Experiment No 1** | Measurement of strain using strain gauge on mechanical component and determine a force deflection curve using DAQ system | **( 2 )** |
| **Experiment No 2** | Measurement of acceleration using accelerometer on vibrating machine, Conducting FFT analysis of signals received from sensor | **( 2 )** |
| **Experiment No 3** | Condition Monitoring and Fault Diagnostics of Vehicle components using FFT Analyzer | **( 2 )** |
| **Experiment No 4** | Measurement of Noise spectrum of Machine and estimation of noise level using noise sensor | **( 2 )** |
| **Experiment No 5** | Modal analysis of prismatic sections (1-DoF, 2-DoF and Distributed Parameter System) using vibration excitation table | **( 2 )** |
| **Experiment No 6** | Conduction of Literature Survey and Development of Research Proposal | **( 2 )** |
| **Experiment No 7** | Modal Analysis and Spectrum (FFT) Analysis of Engine Component using FFT analyzer and Vibration Shaker Table | **( 2 )** |
| **Experiment No 8** | Experimental Measurement of Principal stress and Principal strain using Strain Rosset of Cantilever Beam | **( 2 )** |

| **Useful Links** | |
|---|---|
| **1.** | http://nptel.iitm.ac.in |

## Mapping of COs and POs

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 6 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 2 | 3 | 2 | 1 | | 1 | 2 | 3 | 3 | | 3 | 3 | 3 | 2 | |
| CO 2 | 1 | | | 3 | 2 | | 3 | 3 | 2 | | | | | 3 | 3 |
| CO 3 | 3 | 3 | | 3 | | 3 | 2 | | 3 | | | 3 | 2 | | 1 |
| CO 4 | 2 | | 2 | 3 | 1 | 3 | 3 | 3 | 3 | 2 | | | | 3 | |
| CO 5 | | | 3 | | 3 | 1 | 2 | 1 | | 2 | 1 | 3 | 2 | 2 | 3 |

## Assessment Pattern (with revised Bloom's Taxonomy)

| Knowledge Level | CT 1 | CT 2 | TA | ESE |
|---|---|---|---|---|
| Remember | | | 3 | 3 |
| Understand | | | 4 | 4 |
| Apply | | | 4 | 5 |
| Analyse | | | 4 | 3 |
| Evaluate | | | 4 | 4 |
| Create | | | 6 | 6 |
| TOTAL | | | 25 | 25 |

| Government College of Engineering, Karad | | | | |
|---|---|---|---|---|
| M Tech-First Year (Sem – I) Design Engineering | | | | |
| DE1107: Lab Practice – II | | | | |
| **Teaching Scheme** | | | **Examination Scheme** | |
| Practical | 04 Hrs/week | | CT – 1 | 00 |
| Tutorials | 00 Hrs/week | | CT – 2 | 00 |
| Total Credits | 02 | | TA | 25 |
| | | | ESE | 25 |
| | | | Duration of ESE | 02 Hrs 30 Min |

**Course Outcomes (CO)**

| | |
|---|---|
| **1.** | The students will be able to simulate Single DoF vibration problem |
| **2.** | The students will be able to carry out numerical simulation of vibration problems |
| **3.** | The students will be able to conduct static and dynamic FEA simulation of Machine components |
| **4.** | The students will be able to simulate linear and nonlinear optimization problem |

| | Course Contents | Hours |
|---|---|---|
| **Experiment No 1** | Simulation of Single DoF vibration problem: Free, Forced, damped and Unddamped and also verify law of conservation in spring mass damper system | **( 2 )** |
| **Experiment No 2** | Numerical Simulation of Linear and Nonlinear ODE (may be simple pendulum or spring mass damper system) using RK method and MATLAB ODE solvers | **( 2 )** |
| **Experiment No 3** | FEA Static Simulation of Machine Component | **( 2 )** |
| **Experiment No 4** | FEA Modal as well as Harmonic Simulation of Machine Component | **( 2 )** |
| **Experiment No 5** | Simulation of Simplex Optimization Problems and its graphical simulation using MATLAB | **( 2 )** |
| **Experiment No 6** | Simulation of Nonlinear Optimization of problems using MATLAB | **( 2 )** |
| **Experiment No 7** | Simulation of Principal Stresses and Principal Planes and graphical representation using MATLAB | **( 2 )** |
| **Experiment No 8** | Contact FEA simulation using ANSYS | **( 2 )** |

**Useful Links**

| | |
|---|---|
| **1.** | http://nptel.iitm.ac.in |

**Mapping of COs and POs**

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 6 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 2 | 3 | 2 | 1 | | 1 | 2 | 3 | 3 | | 3 | 3 | 3 | 2 | |
| CO 2 | 1 | | | 3 | 2 | | 3 | 3 | 2 | | | | | 3 | 3 |
| CO 3 | 3 | 3 | | 3 | | 3 | 2 | | 3 | | | 3 | 2 | | 1 |
| CO 4 | 2 | | 2 | 3 | 1 | 3 | 3 | 3 | 3 | 2 | | | | 3 | |
| CO 5 | | | 3 | | 3 | 1 | 2 | 1 | | 2 | 1 | 3 | 2 | 2 | 3 |

**Assessment Pattern (with revised Bloom's Taxonomy)**

| Knowledge Level | CT 1 | CT 2 | TA | ESE |
|---|---|---|---|---|
| Remember | | | 3 | 2 |
| Understand | | | 5 | 5 |
| Apply | | | 2 | 5 |
| Analyse | | | 5 | 5 |
| Evaluate | | | 5 | 5 |
| Create | | | 5 | 3 |
| TOTAL | | | 25 | 25 |

## Government College of Engineering, Karad

## First Year (Sem – I) M. Tech. Mechanical-Design Engineering

## OE1138: Operations Research

| Teaching Scheme | | | Examination Scheme | |
|---|---|---|---|---|
| Lectures | 03 Hrs/week | | CT – 1 | 15 |
| Tutorials | -- | | CT – 2 | 15 |
| Total Credits | 03 | | TA | 10 |
| | | | ESE | 60 |
| | | | Duration of ESE | 02 Hrs 30 Min |

**Course Outcomes (CO)**

At the end of the course, the students will able to

| | |
|---|---|
| **1.** | apply the dynamic programming to solve problems of discreet and continuous variables. |
| **2.** | apply the concept of non-linear programming |
| **3.** | carry out sensitivity analysis |
| **4.** | model the real-world problem and simulate it. |

| | Course Contents | Hours |
|---|---|---|
| **Unit 1** | Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models | **(06)** |
| **Unit 2** | Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming | **(07)** |
| **Unit 3** | Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT | **(06)** |
| **Unit 4** | Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming. | **(06)** |
| **Unit 5** | Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation | **(07)** |

**Text Books**


| | |
|---|---|
| **1.** | J.C. Pant, Introduction to Optimization: Operations Research, Jain Brothers, Delhi, 2008 |
| **2.** | Hitler Libermann Operations Research: McGraw Hill Pub. 2009 |
| **3.** | Pannerselvam, Operations Research: Prentice Hall of India 2010 |


**Reference Books**


| | |
|---|---|
| **1.** | H.A. Taha, Operations Research, An Introduction, PHI, 2008 |
| **2.** | H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982. |
| **3.** | Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010 |

## Government College of Engineering, Karad

## First Year (Sem – I) M. Tech. Mechanical- Design Engineering

## AU1119: Research Paper Writing (Audit Course – 1)

| Teaching Scheme | | | Examination Scheme | |
|---|---|---|---|---|
| Lectures | 02 Hrs/week | | CT – 1 | -- |
| Tutorials | - | | CT – 2 | -- |
| Total Credits | 00 | | TA | -- |
| | | | ESE | -- |
| | | | Duration of ESE | -- |

**Course Outcomes (CO)**

At the end of the course students will able to:

| | |
|---|---|
| **1.** | Understand that how to improve your writing skills and level of readability. |
| **2.** | Learn about what to write in each section. |
| **3.** | Understand the skills needed when writing a Title |

| | Course Contents | Hours |
|---|---|---|
| **Unit 1** | Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness | **(04)** |
| **Unit 2** | Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction | **(04)** |
| **Unit 3** | Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check. | **(04)** |
| **Unit 4** | Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, | **(04)** |
| **Unit 5** | Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions | **(04)** |
| **Unit 6** | Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission | **(04)** |

**Tutorials-** --

**Text Books**

| | |
|---|---|
| **1.** | Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books) |
| **2.** | Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press |

**Reference Books**

| | |
|---|---|
| **1.** | Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book. |
| **2.** | Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011 |

## Government College of Engineering, Karad

## First Year (Sem – I) M. Tech. Mechanical- Design Engineering

## AU1129: Disaster Management (Audit Course – I)

| Teaching Scheme | | | Examination Scheme | |
|---|---|---|---|---|
| Lectures | 02 Hrs/week | | CT – 1 | -- |
| Tutorials | - | | CT – 2 | -- |
| Total Credits | 00 | | TA | -- |
| | | | ESE | -- |
| | | | Duration of ESE | -- |

**Course Outcomes (CO)**

At the end of the course, the students will:

| | |
|---|---|
| **1.** | learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response |
| **2.** | critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives |
| **3.** | develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations. |

| | Course Contents | Hours |
|---|---|---|
| **Unit 1** | **Introduction**<br>Disaster: Definition, Factors and Significance; Difference Between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude. | **(04)** |
| **Unit 2** | **Repercussions of Disasters** and **Hazards:** Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem.<br>**Natural Disasters**: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches,<br>**Man-made disaster**: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts. | **(04)** |
| **Unit 3** | **Disaster Prone Areas in India**<br>Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases And Epidemics | **(04)** |
| **Unit 4** | **Disaster Preparedness and Management**<br>Preparedness: Monitoring of Phenomena Triggering A Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness. | **(04)** |
| **Unit 5** | **Risk Assessment**<br>Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques at Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival | **(04)** |
| **Unit 6** | **Disaster Mitigation**<br>Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India. | **(04)** |

**Tutorials-** --

**Text Books**


| | |
|---|---|
| **1.** | R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies", New Royal book Company. |
| **2.** | Sahni, Pardeep Et.Al. (Eds.), "Disaster Mitigation Experiences and Reflections", Prentice Hall of India, New Delhi. |
| **3.** | Goel S. L., Disaster Administration and Management Text And Case Studies", Deep &Deep Publication Pvt. Ltd., New Delhi |

## Government College of Engineering, Karad

## First Year (Sem – II) M. Tech. Mechanical- Design Engineering

## DE 1201: Finite Element Analysis

| Teaching Scheme | | | Examination Scheme | |
|---|---|---|---|---|
| Lectures | 03 Hrs/week | | CT – 1 | 15 |
| Tutorials | 00 Hrs/week | | CT – 2 | 15 |
| Total Credits | 03 | | TA | 10 |
| | | | ESE | 60 |
| | | | Duration of ESE | 02 Hrs 30 Min |

**Course Outcomes (CO)**

| | |
|---|---|
| **1.** | Understand the fundamentals of fundamentals of Finite Element Analysis and Variational Principles |
| **2.** | Analyse and develop program for 1D FEA analysis for structural and heat transfer analysis |
| **3.** | Understand and formulate 2D FEA problems |
| **4.** | Solve and analyse Dynamic problems using FEA and create a FEA 1D code |
| | |

| | Course Contents | Hours |
|---|---|---|
| **Unit 1** | Introduction to FEM, basic concepts, historical background, applications of FEM, general description, comparison of FEM with other methods, variational approach, Galerkin's Methods. Co-ordinates, basic element shapes, interpolation function, Virtual energy principle, Rayleigh – Ritz method, properties of stiffness matrix, treatment of boundary conditions, solution of system of equations, shape functions and characteristics, Basic equations of elasticity, strain- displacement relations. | **(04)** |
| **Unit 2** | 1-D Structural Problems: Axial bar element – stiffness matrix, load vector, temperature effects, Quadratic shape functions, and problems. Analysis of Trusses: Plane Trusses and Space Truss elements and problems Analysis of Beams: Hermite shape functions – stiffness matrix – Load vector – Problems. | **(10)** |
| **Unit 3** | 2-D Problems: CST, LST, force terms, Stiffness matrix and load vectors, boundary conditions, Iso-parametric elements – quadrilateral element, shape functions – Numerical Integration. Finite element modelling of Axi-symmetric solids subjected to Axi-symmetric loading with triangular elements. 3-D Problems: Tetrahedron element – Jacobian matrix – Stiffness matrix. | **(10)** |
| **Unit 4** | Steady state heat transfer, 1 D heat conduction governing equation, Boundary conditions, One dimensional element, Functional approach for heat conduction, Galerkin approach for heat conduction, Heat flux boundary condition | **(04)** |
| **Unit 5** | Formulation for point mass and distributed masses, Consistent element mass matrix of one-dimensional bar element, truss element, axisymmetric triangular element, quadrilateral element, beam element. Lumped mass matrix, Evaluation of Eigen values and Eigen vectors, Applications to bars, stepped bars, and beams. Introduction to FES software Packages, Algorithmic approach for developing the code by the individuals | **(08)** |
| **Unit 6** | Non-linear Analysis - Sources and types of non-linearity, Incremental approach to solution of nonlinear problems, Iterative solution methodologies, Considerations for simulation of non-linear problems. | **(04)** |

**Tutorials/ assignments**

- Implementation of FEA MATLAB programs on
  - 1D structural analysis
  - 1D Heat Transfer problem
  - 1D dynamic analysis
- Implementation of FEA using commercial ANSYS package
  - Stress analysis of bracket
  - Structural analysis of pump analysis for rigidity analysis
  - Heat Transfer and Thermal stress analysis of Engine Block
  - Contact analysis

| Text Books | |
|---|---|
| **1.** | Rao S. S. "Finite Elements Method in Engineering"- 4th Edition, Elsevier,2006 |
| **2.** | J.N. Reddy, "Finite Element Method"-McGraw-Hill International Edition |
| **3.** | Bathe K. J. Finite Elements Procedures, PHI. Cook R. D., et al. "Concepts and application of Finite Elements Analysis"-4th Edition, Wiley &Sons,2003. |
| **4.** | Chandrupatla T.R., "FiniteElementsinengineering"-2nd Editions, PHI,2007.2. |
| **5.** | Frank L. Stasa," Applied finite Element Analysis for Engineers", CBS International Edition,1985. |
| **Reference Books** | |
| **1.** | Zeinkovich, "The Finite Element Method for Solid and Structural Mechanics, 6th Ed., Elsevier2007. |

## Mapping of COs and POs

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| CO 2 | 3 | 3 | 2 | 3 | 3 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| CO 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 2 | 3 |
| CO 4 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | | 3 | 1 | 1 | 2 | 3 | 3 | 2 |

## Assessment Pattern **(with revised Bloom's Taxonomy)**

| Knowledge Level | CT 1 | CT 2 | TA | ESE |
|---|---|---|---|---|
| Remember | 3 | 3 | 1 | 10 |
| Understand | 3 | 3 | 2 | 10 |
| Apply | 3 | 3 | 2 | 10 |
| Analyse | 2 | 2 | 2 | 10 |
| Evaluate | 2 | 2 | 2 | 10 |
| Create | 2 | 2 | 1 | 10 |
| TOTAL | 15 | 15 | 10 | 60 |

## Government College of Engineering, Karad

## First Year (Sem – II) M. Tech. Mechanical- Design Engineering

## DE 1202: Computer Aided Design

| Teaching Scheme | | | Examination Scheme | |
|---|---|---|---|---|
| Lectures | 03 Hrs/week | | CT – 1 | 15 |
| Tutorials | 00 Hrs/week | | CT – 2 | 15 |
| Total Credits | 03 | | TA | 10 |
| | | | ESE | 60 |
| | | | Duration of ESE | 02 Hrs 30 Min |

**Course Outcomes (CO)**

| | |
|---|---|
| **1.** | Understand the fundamentals of Geometric modelling |
| **2.** | Develop and manipulate the curves and surfaces using parametric equations |
| **3.** | Implement the transformation and projection over the geometric model |
| **4.** | Develop and manipulate the solid models using different modelling approaches |

| | Course Contents | Hours |
|---|---|---|
| **Unit 1** | Introduction: Definitions, Historical developments. Geometric Modeling, Nameable Unnamable shapes, Affine and convex combination. Introduction to Equations - Implicit, explicit, parametric. Coordinate systems | **(04)** |
| **Unit 2** | Design of Curves: Cubic Hermite curves - Algebraic and geometric forms, Blending functions, Subdivision, Reparameterization, Truncating, Extenuating and subdividing. Space curve, four point form, straight line and Composite Hermite curves (C^n and G^n continuity).Spline curve, Bezier curves - Control polygons and Bernstein basis, De Casteljau algorithm, First and second derivatives at the ends, Continuity aspects. B-Spline Curves - periodic, open and non-uniform knot vectors and corresponding curves, Rational B-splines, NURBS, and Quadratic variety. | **(10)** |
| **Unit 3** | Design of surfaces: Hermite Surface - Algebraic and geometric form, tangent and twist vectors, Normal, parametric space of a surface, blending functions, Subdivision and Reparameterization, Continuity of surfaces. Sixteen point form , four curve form, plane surface, cylindrical surface, ruled surface, surface of revolution. Bezier surface - Control net representation, Direct and indirect De Casteljau algorithm for Bezier surface, Continuity aspects. B-Spline Surfaces - periodic, open and non-uniform knot vectors and corresponding surfaces, Rational B-splines, NURBS. | **(10)** |
| **Unit 4** | Transformations in 2D and 3D, Translation, Rotation, Scaling Symmetry and Reflection, affine transformation. Homogeneous Transformation. Orthotropic projections, Axonometric Projections, Oblique Projections, perspective Transformations. | **(04)** |
| **Unit 5** | Introduction to Solid Modelling - Topology of closed paths, piecewise Flat surface, Topology of closed curved surfaces, Generalised concept of boundary, set theory, Boolean operators(Union, Difference and Intersection) , Set memberships classification, Euler and modified form of equations.<br><br>Solid model construction: Graph based methods, Boolean models, Instances and parameterised shapes, Cell decompositions, Representations - Quadtree, Octree, Half space, sweep, Boundary Representation (B-Rep), Constructive Solid Geometry (CSG) | **(08)** |
| **Unit 6** | Introduction to analytical properties, relational properties and intersections, data transfer formats for Cad. Applications | **(04)** |

**Tutorials/ assign ments**

Implementations of the algorithms on MATLAB such as:

- Hermite curve
- Hermite/Bezier surface
- B-spline curve/surface)
- 2D Transformation
- Construction of solid and surface Models on any of the high end solid modellers ( Nx 11.0, solid works)

| | | | | |
|---|---|---|---|---|
| **Text Books** | | | | |
| **1.** | Geometric Modelling, Michael E. Mortenson | | | |
| **2.** | Mathematical Elements of Computer Graphics, David Rogers and Alan Adams | | | |
| **3.** | Curves and Surfaces for CAGD, Geral E. Farin | | | |
| **4.** | Introduction to Solid Modelling, Martii Mantyla | | | |
| **5.** | CAD CAM Theory And Practice , Ibrahim Zeid | | | |
| **Reference Books** | | | | |
| **1.** | The NURBS Book. Piegel.Tiller | | | |
| | | | | |

## Mapping of COs and POs

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| CO 2 | 3 | 3 | 2 | 3 | 3 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| CO 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 2 | 3 |
| CO 4 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | | 3 | 1 | 1 | 2 | 3 | 3 | 2 |

## Assessment Pattern**(with revised Bloom's Taxonomy)**

| Knowledge Level | CT 1 | CT 2 | TA | ESE |
|---|---|---|---|---|
| Remember | 3 | 3 | 1 | 10 |
| Understand | 3 | 3 | 2 | 10 |
| Apply | 3 | 3 | 2 | 10 |
| Analyse | 2 | 2 | 2 | 10 |
| Evaluate | 2 | 2 | 2 | 10 |
| Create | 2 | 2 | 1 | 10 |
| TOTAL | 15 | 15 | 10 | 60 |

| Government College of Engineering, Karad | | | | |
|---|---|---|---|---|
| M Tech-First Year (Sem – II) Design Engineering | | | | |
| DE1213: Mechatronics and Control Systems (Elective-III) | | | | |
| **Teaching Scheme** | | | **Examination Scheme** | |
| Lectures | 03 Hrs/week | | CT – 1 | 15 |
| Tutorials | 00 Hrs/week | | CT – 2 | 15 |
| Total Credits | 03 | | TA | 10 |
| | | | ESE | 60 |
| | | | Duration of ESE | 02 Hrs 30 Min |

**Course Outcomes (CO)**

| | |
|---|---|
| **1.** | Understanding working of principles of Sensors, actuators |
| **2.** | Understanding concepts of Data Acquisition System |
| **3.** | Understanding and implementation of control system |
| **4.** | Understanding and developing practical control systems |

| | Course Contents | Hours |
|---|---|---|
| **Unit 1** | Overview of measurement systems Measurement devices;<br>Classification of sensors. Characteristics and calibration of different sensors.<br>**Displacement position and motion sensors**: Principles of variable resistance, variable inductance, variable reluctance, and variable capacitance type sensors. Position and Motion sensors: Limit switches; Proximity sensors: Pneumatic Proximity sensor; Optical Proximity sensor; Inductive Proximity sensor; Capacitive Proximity sensor; Ultrasonic Proximity sensor<br>**LVDT:** construction; working principle, signal conditioning; use of LVDT<br>The Tachogenerator: DC Tachogenerator, Digital Tachogenerator; Optical type and magnetic type, Synchros and resolver. Encoders: types of encoder;<br>**Hall sensors:** Working principle; Hall effect gear tooth sensor, Distance sensors<br>**Light Sensor:** Photovoltaic; Photoconductive (Photo resistors)<br>**Accelerometer:** Definition; General Construction; Working Principle; Types of Accelerometer Servo Type; Piezo Resistive Type; Capacitive Type; Variable reluctance type; Errors; Variable reluctance circuit geometry ; Auto null sensor amplifier; force balance servo sensor. | **(06)** |
| **Unit 2** | **Strain Gauges:** Working principle; construction, poisson's ratio; Gauge factor, Piezo resistance Coefficient: strain sensing alloys; characteristics; gauges length, rosettes;<br>Pressure sensor: Definition on pressure, Static, head, dynamic pressure. Classification of pressure;<br>**Application of Diaphragm:** Capacitance Type. Reluctance Type, Strain Gauge Type and Inductive Type.<br>**Application of Bellows**: Differential pressure; Pneumatic Servo mechanism type. Electrical and Piezoelectric pressure transducers, McLeod gage, Pirani gage and Ionisation gage<br>**Flow sensors:** The flow pioneers Reynolds numbers, principle of flow measurement Head type flow meter, Electromagnetic flow meter, Rotameter, Anemometer, Ultrasonic flow meter<br>**Smart Sensor:** Methods of internal compensation, information coding, integrated sensor principles, present trends | **(06)** |
| **Unit 3** | **Analog Signal Conditioning:** Introduction, Principles of Analog Signal conditioning, Signal-level Changing, linearization, Conversions, Zero adjustment, Span adjustment, Filtering and Impedance Matching, Passive Circuit, Driver Circuit, Bridge Circuits, RC Fitters Operational Amplifiers, Characteristic Op Amp circuits in Instrumentation, voltage follower, Differential Amplifier, Instrumentation amplifier, Active Filters. Voltage-to-Current Converter, Current-to-voltage Converter. Linearization<br>**Digital Signal Conditioning:** Review of digital Fundamentals, Busses and Tri-State Buffers, Converters, Comparators, Digital-to- Analog Converters (DAC), Analog-to-Digital Converters (ADCs), Sample and Hold, Multiplexer and De-multiplexer, decoder and encoder, Pulse modulations, Digital recorder, Programmable Logic Controller<br>**Data Acquisition System:** Introduction, Analog arid Digital Data Acquisition Systems, Block diagram, Components, CPU, Memory, input / Output, sensors, ADC, DAC Sample and Hold, Multiplexing and De-multiplexing, Modulation, Display, Recording, alarm Programming, Voltage, Current, Frequency, | **(06)** |

| | | |
|---|---|---|
| | Temperature. Displacement, Pressure measurement using Data Acquisition System (DAS), Application of Data Acquisition System in Power plant, Project control plant and Automation, Data logger | |
| **Unit 4** | **Basic control schemes and controllers:** On - off Control, Time proportional control, PI Control; PD Control; PID Control. Controller: Block diagram Types of controllers; Sell operated controllers; Electronic controller; Analog controller; Pneumatic controller, comparison between Pneumatic & electronic controller, Hydraulic Controller; Programmable logic Controller (PLC) | **(08)** |
| **Unit 5** | **Modern Control:** Concepts of states, State variable and state models linear continuous time and discrete time, state space models, similarity transformation, transform function to state space representation controllability and stabilizability, absorbability and detectability canonical decomposition, polo assignment by state feedback, Observers, continuing state feedback with an observer | **(06)** |
| **Unit 6** | **Non-Linear Control System:** Introduction, Common physical nonlinearities. The phase — plane method, singular points, Stability of non-linear system, Construction of phase — trajectories, System analysis by phase plane method, The describing function method, Derivation of describing function, Stability analysis by describing function methods, Jump resonance Liapunov's stability criterion. | **(07 )** |

| **Tutorials** | |
|---|---|
| 1. | Interfacing sensors to microcontroller (Arduino, Raspberry PI) |
| 2. | Commanding to Actuators (stepper motor, DC motor) through Arduino or Raspberry Pl |
| 3. | study of Signal Processing (Bit accuracy, bit width and Sampling) |
| 4. | Experiments on dSPACE DS1104 microcontroller |
| 5. | Design of PID control system using MATLAB programming |

| **Text Books** | |
|---|---|
| **1.** | Ramesh S. Gaonkar, Microprocessor Architecture Programming and Applications", New Age International publishers Ltd. |
| **2.** | W. Bolton, "Mechatronics" Pearson Education, 4th Edition, 2008 |
| **3.** | Mahalik, "Mechatronics", TATA McGraw Hill, 2006 |

| **Reference Books** | |
|---|---|
| **1.** | K. P. Ramachandran, "Mechatronics: Integrated Mechanical Electronic Systems (WIND)" Wiley, 2008 |
| **2.** | K. K. Appukuttan, "lntroductlon to Mechatronics", Oxford University Press, 2007 |
| **3.** | Godfrey C. Onwubolu, "Mechatronics: Principles and Applications, Elsevier; First edition 2006 |
| **4.** | Hackworth, "Programmable Logical Controller", Pearson Education, 2008 |

**Mapping of COs and POs**

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 6 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | | | | | | | | | | | | | | | |
| CO 2 | | | | | | | | | | | | | | | |
| CO 3 | | | | | | | | | | | | | | | |
| CO 4 | | | | | | | | | | | | | | | |
| CO 5 | | | | | | | | | | | | | | | |

**Assessment Pattern(with revised Bloom's Taxonomy)**

| Knowledge Level | CT 1 | CT 2 | TA | ESE |
|---|---|---|---|---|
| Remember | | | | |
| Understand | | | | |
| Apply | | | | |
| Analyse | | | | |
| Evaluate | | | | |
| Create | | | | |
| TOTAL | | | | |

## Government College of Engineering, Karad

## M Tech-First Year (Sem – II) M. Tech. Mechanical- Design Engineering

## DE1214: Non-linear and Random Vibrations

| Teaching Scheme | | | Examination Scheme | |
|---|---|---|---|---|
| Lectures | 03 Hrs/week | | CT – 1 | 15 |
| Tutorials | 00 Hrs/week | | CT – 2 | 15 |
| Total Credits | 03 | | TA | 10 |
| | | | ESE | 60 |
| | | | Duration of ESE | 02 Hrs 30 Min |

**Course Outcomes (CO)**

| | |
|---|---|
| **1.** | To prepare the students to succeed as designer in industry/technical profession. |
| **2.** | To provide student knowledge of reliability and maintainability of machines and systems. |
| **3.** | To train the students to apply knowledge of probability for reliability analysis of machines and mechanisms. |
| **4.** | To prepare the students to use reliability theory for product life calculation and for maintenance of machines and mechanical systems. |

| | Course Contents | Hours |
|---|---|---|
| **Unit 1** | **Introduction:** Definition of non-linear systems and comparison between the behavior of linear and nonlinear systems. Undamped and damped free and forced vibrations. Self-excited oscillations, singular points, analytical methods. Stability concept, phase plane plots, limit cycle. | **(7)** |
| **Unit 2** | **Probability Theory:** Random Vibrations - Probability distribution and density functions - Excreted values - Conditional probability - Characteristic and log characteristic functions - Chebycshev inequality - Functions of random variables. | **( 7 )** |
| **Unit 3** | **Random Processes - I:** Concept of stationary and ergodicity - Evolutionary nonostationary process - Auto and cross correlation and covariance Functions - Mean square limit, differentiability and inerrability - Spectral decomposition. | **( 7 )** |
| **Unit 4** | **Random Processes - II:** Power spectral and cross spectral density Factions - Wiener - Khintchine relations - Properties of Gaussian. Poisson and Markov processes –Fokker - Planck Equation - Broad band and narrow band random processes - white noise. | **( 7 )** |
| **Unit 5** | **Random Vibrations - I:** Response of linear single and multi - degree of freedom systems to stationary excitation - Response of continuous systems - Normal mode method. | **( 7 )** |
| **Unit 6** | **Random Vibrations - II:** Level crossing, peak and envelop statistics - First excursion and fatigue. | **( 5 )** |

**Text Books**


| | |
|---|---|
| **1.** | Lishakoff, I., " Probabilistic Methods in the Theory of Structures", John Wiley, New York, 1983. |
| **2.** | Newland, D.E., " An Introduction to Random Vibrations and Spectral Analysis", Longman Inc., New York, Second Edition, 1984. |


**Reference Books**


| | |
|---|---|
| **1.** | Nigam, N.C., "Introduction to Random Vibrations". MIT Press, Cambridge, Massachusettes, 1983 |
| **2.** | Nigam, N.C. and Narayanan, S., "Applications of Random Vibrations", Narosa Publications,1995 |

## Mapping of COs and POs

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 6 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 2 | 3 | 3 | 1 | | 2 | 1 | 3 | 2 | | 3 | 2 | 3 | 2 | |
| CO 2 | 2 | | | 3 | 2 | | 3 | 3 | 1 | | | | | 3 | 3 |
| CO 3 | 1 | 2 | | 2 | | 1 | 1 | 1 | 3 | 2 | | 3 | 2 | | 2 |
| CO 4 | 2 | | 3 | 3 | 1 | 3 | 3 | 1 | 1 | 2 | | | | 2 | |
| CO 5 | | | 1 | | 1 | 3 | 2 | 2 | | 2 | 2 | 2 | 3 | 2 | 1 |

## Assessment Pattern (with revised Bloom's Taxonomy)

| Knowledge Level | CT 1 | CT 2 | TA | ESE |
|---|---|---|---|---|
| Remember | 3 | 3 | 1 | 10 |
| Understand | 3 | 3 | 2 | 10 |
| Apply | 3 | 3 | 2 | 10 |
| Analyse | 2 | 2 | 2 | 10 |
| Evaluate | 2 | 2 | 2 | 10 |
| Create | 2 | 2 | 1 | 10 |
| TOTAL | 15 | 15 | 10 | 60 |

## Government College of Engineering, Karad

## M Tech-First Year (Sem – II) M. Tech. Mechanical- Design Engineering

## DE1224: Condition Monitoring

| Teaching Scheme | | | Examination Scheme | |
|---|---|---|---|---|
| Lectures | 03 Hrs/week | | CT – 1 | 15 |
| Tutorials | 00 Hrs/week | | CT – 2 | 15 |
| Total Credits | 03 | | TA | 10 |
| | | | ESE | 60 |
| | | | Duration of ESE | 02 Hrs 30 Min |

**Course Outcomes (CO)**

| | |
|---|---|
| **1.** | To prepare the students to succeed as designer in industry/technical profession. |
| **2.** | To provide students with a sound foundation in noise and vibration control to & solve the problems in process industry. |
| **3.** | To train the students with good design engineering breadth required for safe and efficient design, construction, installation, inspection, testing and certification of machines. |
| **4.** | To aware the students about application of monitoring methods for preventive maintenance. |

| | Course Contents | Hours |
|---|---|---|
| **Unit 1** | **Module 1:** Introduction: Definition, Need and relevance to maintenance, Different techniques and their practical applications. Maintenance Principles, FMECA, Fault Prognosis. | **( 5 )** |
| **Unit 2** | **Module 2:** Vibration and AE based condition monitoring, Measurement of vibration and acoustic emission – Measuring parameters, Transducers, selection of appropriate parameters and transducers. Data acquisition and signal processing: A/D converters, Filters. | **( 8 )** |
| **Unit 3** | **Module 3:** Analysis and interpretation of vibration and AE data, Time & Frequency domain analysis, Analysis of stationary and non-stationary signals- FFT, Wavelet Transform, Hilbert Transform, Cepstrum analysis in machine condition monitoring, Modulation and Sidebands, Order Analysis, Orbits. | **( 7 )** |
| **Unit 4** | **Module 4:** Oil & wear debris analysis and ferrography: Principles, methods and instruments for wear debris analysis and ferrography. | **( 7 )** |
| **Unit 5** | **Module 5:** NDT, Ultrasonic, Eddy Current testing- Measurement of surface and subsurface flaws – liquid penetrant inspection, eddy current inspection, radiographic inspection, ultrasonic inspection. | **( 7)** |
| **Unit 6** | **Module 6:** Condition monitoring of various machine components and machines like bearings, gears, pumps, compressors, turbines, machine tools, cutting tools, etc. to diagnose various defects. Machinery prognostics, prediction of failures, concept of integrated analysis, Failure Analysis | **( 6 )** |
| **Tutorials** | | |
| **Text Books** | | |


| | |
|---|---|
| **1.** | Randall R. B., "Vibration Based Condition Monitoring," Ch.1, Ch. 2, Ch 3, Wiley, New Delhi, 2010 |
| **2.** | J. H. William and others, "*Condition Based Maintenance and M/C Diagnostics*", Business & economics, 2nd edition, 1994. |
| **3.** | Alan Davies, "Handbook of Condition Monitoring: Techniques & Methodology," Chapman & Hall, London, 1998 |


**Reference Books**


| | |
|---|---|
| **1.** | J.H. Williams, A. Davies, P.R. Drake, "Condition-based Maintenance and Machine Diagnostics" Springer Science & Business Media, 31-Jul-1994 |

## Mapping of COs and POs

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 6 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 2 | 1 | 2 | 2 | | 3 | 1 | 2 | 1 | | 2 | 2 | 3 | 1 | 2 |
| CO 2 | 2 | 2 | | 3 | 2 | | 3 | | 3 | | | | | 2 | 3 |
| CO 3 | 1 | 1 | | 3 | | 1 | 3 | 1 | 3 | 2 | | 3 | 2 | | 3 |
| CO 4 | 2 | | 3 | 1 | 3 | 2 | 2 | 2 | 3 | 2 | | | | 3 | |
| CO 5 | | | 3 | | 2 | 1 | 2 | 2 | | 1 | 2 | 2 | 3 | 3 | 3 |

## Assessment Pattern (with revised Bloom's Taxonomy)

| Knowledge Level | CT 1 | CT 2 | TA | ESE |
|---|---|---|---|---|
| Remember | 3 | 3 | 1 | 10 |
| Understand | 3 | 3 | 2 | 10 |
| Apply | 3 | 3 | 2 | 10 |
| Analyse | 2 | 2 | 2 | 10 |
| Evaluate | 2 | 2 | 2 | 10 |
| Create | 2 | 2 | 1 | 10 |
| TOTAL | 15 | 15 | 10 | 60 |

## Government College of Engineering, Karad

## M Tech-First Year (Sem –II ) M. Tech. Mechanical- Design Engineering

## DE1234: Synthesis of Mechanisms

| Teaching Scheme | | | Examination Scheme | |
|---|---|---|---|---|
| Lectures | 03 Hrs/week | | CT – 1 | 15 |
| Tutorials | 00 Hrs/week | | CT – 2 | 15 |
| Total Credits | 03 | | TA | 10 |
| | | | ESE | 60 |
| | | | Duration of ESE | 02 Hrs 30 Min |

**Course Outcomes (CO)**

| | |
|---|---|
| **1.** | To prepare the students to succeed as designer in industry/technical profession |
| **2.** | To provide students with a sound foundation in kinematic and synthesis of machines and Mechanisms |
| **3.** | To train the students to apply complex number, matrices and algebra for analysis of Mechanisms |
| **4.** | To prepare the students to use modern software for kinematic and dynamic analysis of the mechanisms. |

| | Course Contents | Hours |
|---|---|---|
| **Unit 1** | **Module 1:** Kinematics in elements in pairs, Mechanisms with higher and lower pairs, Dimensional synthesis of mechanisms, Chebyshov-polynomials, Spacing of accuracy points. | **( 7 )** |
| **Unit 2** | **Module 2:** Four bar coupler points curves- Equation of coupler curves, Robort Chebyshov theorem, double points and symmetry, Euler Savary equation and cube of stationery curvature. | **( 7 )** |
| **Unit 3** | **Module 3:** Geometric Methods of synthesis of planner Mechanisms- Two finitely separated link positions, three separate link positions, poles and relative poles, Synthesis with three accuracy points, four finitely separated link positions, pole triangle, image poles, opposite poles, quadrilateral circle points and center points curves, synthesis with four accuracy point. | **( 7 )** |
| **Unit 4** | **Module 4:** Algebra method of synthesis of planer mechanisms – Displacement equations of the four bar linkage, synthesis with three accuracy points , synthesis with prescribed velocity and acceleration, synthesis with four accuracy points, structural error curve, analysis of mechanical error in linkages. | **( 7 )** |
| **Unit 5** | **Module 5:** Complex numbers- Velocity and acceleration synthesis, couple synthesis, analysis of mechanisms ,error in linkages | **( 7 )** |
| **Unit 6** | **Module 6**: Spatial mechanisms-Synthesis of spatial linkages, displacement analysis, matrix method of analysis, function generator for symmetric function, application of spatial mechanisms to Robotics , kinematics analysis of industrial robots, manipulators , gripper theory , Computer aided analysis of mechanisms and introduction to dynamic analysis mechanisms. | **( 5 )** |

**Text Books**


| | |
|---|---|
| **1.** | Arthur G Erdman and George N. Sander, "*Mechanisms Design Analysis and Synthesis Volume I, II*",4th edition, 2001. |
| **2.** | J.E. Shigley&J.J.Vickel, "*Theory of Machines and Mechanisms*", International students edition, 2001. |
| **3.** | J.E. Shigley , "*Kinematic Analysis of Mechanism*", MacGraw Hill, 1969. |


**Reference Books**


| | |
|---|---|
| **1.** | Wilson C E, Sadler J P, "Kinematics and Dynamics of Machinery*",* HRP, First Edition, 1990. |
| **2.** | Waldron K J, Kinzel G L, "*Kinematics, Dynamics and Design of Machinery",* Wiley India, First Edition, 2004. |

## Mapping of COs and POs

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 6 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 2 | 1 | 3 | 1 | | 3 | 1 | 2 | 3 | | 2 | 3 | 3 | 2 | 2 |
| CO 2 | 3 | 2 | 2 | 3 | 2 | | 3 | | 3 | | | | | 2 | 3 |
| CO 3 | 1 | 2 | | 1 | | 1 | 3 | 1 | 3 | 2 | | 3 | 3 | | 1 |
| CO 4 | 2 | | | 2 | 2 | 3 | 3 | 1 | 2 | 2 | | | | 2 | |
| CO 5 | | | 1 | | 1 | 2 | 3 | 1 | | 3 | 1 | 3 | 2 | 2 | 2 |

## Assessment Pattern(with revised Bloom's Taxonomy)

| Knowledge Level | CT 1 | CT 2 | TA | ESE |
|---|---|---|---|---|
| Remember | 3 | 3 | 1 | 10 |
| Understand | 3 | 3 | 2 | 10 |
| Apply | 3 | 3 | 2 | 10 |
| Analyse | 2 | 2 | 2 | 10 |
| Evaluate | 2 | 2 | 2 | 10 |
| Create | 2 | 2 | 1 | 10 |
| TOTAL | 15 | 15 | 10 | 60 |

## Government College of Engineering, Karad

## M Tech-First Year (Sem -II) M. Tech. Mechanical- Design Engineering

## DE1244: Vehicle Dynamics

| Teaching Scheme | | | Examination Scheme | |
|---|---|---|---|---|
| Lectures | 03 Hrs/week | | CT – 1 | 15 |
| Tutorials | 00 Hrs/week | | CT – 2 | 15 |
| Total Credits | 03 | | TA | 10 |
| | | | ESE | 60 |
| | | | Duration of ESE | 02 Hrs 30 Min |

**Course Outcomes (CO)**

| | |
|---|---|
| **1.** | Analyse suspension, steering characteristics and tyre properties |
| **2.** | Evaluate the various ride excitation sources |
| **3.** | Design vehicle systems with reference to handling and ride |

| | Course Contents | Hours |
|---|---|---|
| **Unit 1** | **Introduction to vehicle dynamics:** Various automobile systems and their functions, vehicle layouts, vehicle power trains, vehicle motions. | **( 7 )** |
| **Unit 2** | **Road loads and acceleration performance:** Drive torques and tractive efforts, rolling resistance, aerodynamic – drag, lift and side forces, total road loads, loads on grades, power limited and traction limited acceleration, gradeability | **( 7 )** |
| **Unit 3** | **Suspension systems:** Requirements of suspension system, types and varieties, anti pitching and anti-roll suspension geometry, Roll center analysis for solid axle and independent suspension | **( 7 )** |
| **Unit 4** | **Steering system and tyres:** Steering geometry and steering linkages, forces on steering system, over and under steer characteristics, tyre construction and load rating, tyre properties and influence on vehicle dynamics. | **( 7 )** |
| **Unit 5** | **Vehicles handling:** Steady state cornering, low and high speed cornering, under steer gradient and its effects, critical and characteristic effect, Effect of braking, tyre –road friction, brake proportioning, wheel lockup and pedal forces | **( 7 )** |
| **Unit 6** | **Vehicle ride**: Excitation sources – road, tyres, driveline excitations, vehicle response characteristics, stiffness, damping and suspension isolation, rigid body motions, pitch and bounce frequencies, seat vibrations and ride perception | **( 5 )** |

**Tutorials**

| | |
|---|---|
| 1. | Assignment on Simplex Methods |
| 2. | MATLAB simulation on Nonlinear Optimization |
| 3. | MATLAB simulation on Single Variable Optimization |
| 4. | Assignment on preparation of Topology Optimization |
| 5. | Assignment on Constrained optimization |
| 6 | Assignment on Conjugate Direction Method |

**Text Books**


| | |
|---|---|
| **1.** | Giri N.K., " *Automotive Mechanics*", Khanna Publishers, 2002. |
| **2.** | Rao J.S and Gupta. K, "*Theory and Practice of Mechanical Vibrations*", Wiley Eastern Ltd., New Delhi -2, 2002. |


**Reference Books**


| | |
|---|---|
| **1.** | Giles J., G. Steering - "*Suspension and Tyres*", Illiffe Books Ltd., London- 1998. |
| **2.** | Ham B, Pacejka, "*Tyre and Vehicle Dynamics*",SAE Publication - 2002. |
| **3.** | Gillespie T.D, "*Fundamentals of Vehicle Dynamics*", SAE USA 1992. |

## Mapping of COs and POs

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 6 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 2 | 2 | 3 | 1 | | 1 | 1 | 2 | 2 | 2 | 2 | 3 | 3 | 2 | 3 |
| CO 2 | 3 | 2 | 2 | 3 | 2 | | 3 | | 3 | | 1 | | | | 3 |
| CO 3 | 2 | 1 | | 1 | | 1 | | 1 | 3 | 2 | | 3 | 1 | | 1 |
| CO 4 | 2 | | | 1 | 2 | 2 | 1 | 1 | 1 | 2 | | | | 3 | |
| CO 5 | | | 3 | | 2 | 2 | 2 | 3 | 1 | 3 | 1 | 1 | 3 | 1 | 1 |

## Assessment Pattern (with revised Bloom's Taxonomy)

| Knowledge Level | CT 1 | CT 2 | TA | ESE |
|---|---|---|---|---|
| Remember | 3 | 3 | 1 | 10 |
| Understand | 3 | 3 | 2 | 10 |
| Apply | 3 | 3 | 2 | 10 |
| Analyse | 2 | 2 | 2 | 10 |
| Evaluate | 2 | 2 | 2 | 10 |
| Create | 2 | 2 | 1 | 10 |
| TOTAL | 15 | 15 | 10 | 60 |

## Government College of Engineering, Karad

### M Tech-First Year (Sem – II) M. Tech. Mechanical- Design Engineering

### DE1215: Optimization Techniques (Elective – V)

| Teaching Scheme | | | Examination Scheme | |
|---|---|---|---|---|
| Lectures | 03 Hrs/week | | CT – 1 | 15 |
| Tutorials | 00 Hrs/week | | CT – 2 | 15 |
| Total Credits | 03 | | TA | 10 |
| | | | ESE | 60 |
| | | | Duration of ESE | 02 Hrs 30 Min |

**Course Outcomes (CO)**

| | |
|---|---|
| **1.** | To understand the theory of optimization methods and algorithms developed for solving various types of optimization problems |
| **2.** | To develop and promote research interest in applying optimization techniques in problems of Engineering and Technology |
| **3.** | To apply the mathematical results and numerical techniques of optimization theory to concrete Engineering problems |
| **4.** | To recognize and formulate problems that arise in engineering in terms of optimization problems |

| | Course Contents | Hours |
|---|---|---|
| **Unit 1** | **Linear models:** Linear programming-extensions: Revised simplex method, Dual Simplex method, Bounded variables method, primal-dual relationships, duality theorems, economic 6 interpretation of dual, dual of transportation model, sensitivity analysis in LPP and transportation models, Karmarkar's interior point algorithm | **( 7 )** |
| **Unit 2** | **Dynamic programming:** Formulation, recursive approach, Goal programming: formulation, graphical solution, algorithm Integer programming: Formulation, Cutting plane algorithm, Branch and bound algorithm | **( 7 )** |
| **Unit 3** | **Nonlinear models:** Classical Optimization: Single and Multi-variable Optimization, Hessian Matrix, Saddle Point, Lagrange Multipliers, Kuhn-Tucker Conditions | **( 7 )** |
| **Unit 4** | **Single-variable Optimization:** Unrestricted Search, Exhaustive Search, Dichotomous Search, Interval-halving Method, Fibonacci Method, Golden-section Method, Quadratic Interpolation Method, Newton Method, Quasi-Newton Method, Secant Method Multi-variable Optimization: Evolutionary Optimization Method, Simplex Search Method, Pattern Search Method | **( 7 )** |
| **Unit 5** | Conjugate Direction Method, Steepest Descent Method, Newton's Method, Conjugate Gradient Method, Davidon-Fletcher-Powell Method | **( 7 )** |
| **Unit 6** | Introduction to Constrained Optimization: Interior Penalty Function Method, Exterior Penalty function Method | **( 5 )** |

**Tutorials**

| | |
|---|---|
| 1. | Assignment on Simplex Methods |
| 2. | MATLAB simulation on Nonlinear Optimization |
| 3. | MATLAB simulation on Single Variable Optimization |
| 4. | Assignment on preparation of Topology Optimization |
| 5. | Assignment on Constrained optimization |
| 6 | Assignment on Conjugate Direction Method |

**Text Books**

| | |
|---|---|
| **1.** | Operation Research-An introduction by Hamdy A Taha. Prentice Hall |
| **2.** | Introduction To Management Science, Anderson, Thomson Learning, 11Edn |
| **3.** | Operation Research Applications and Algorithms, Winston, Thomson Learning, 3 4Edn |

**Reference Books**

| | |
|---|---|
| **1.** | Introduction to Operation Research by Hiller/Lieberman. McGraw Hill. |
| **2.** | Optimization for Engine ring Design by Deb & Kalyan way. |
| **3.** | Optimization Theory and application by S. S Rao. |

**Useful Links**

| | |
|---|---|
| **1.** | http://nptel.iitm.ac.in |

## Mapping of COs and POs

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 6 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 2 | 2 | 2 | 3 | | 2 | 1 | 1 | 3 | 2 | 2 | 3 | 3 | 3 | 2 |
| CO 2 | 3 | 2 | 2 | 3 | | | 3 | | 2 | | 1 | | | 2 | 3 |
| CO 3 | 2 | 2 | | | 1 | 3 | | 1 | 3 | 2 | | 3 | 2 | | |
| CO 4 | 2 | | | 2 | 2 | 2 | 3 | 3 | 2 | 2 | | | | 3 | 2 |
| CO 5 | | | 1 | | 1 | 1 | 2 | 2 | 1 | 3 | 2 | 2 | 2 | 3 | 2 |

## Assessment Pattern (with revised Bloom's Taxonomy)

| Knowledge Level | CT 1 | CT 2 | TA | ESE |
|---|---|---|---|---|
| Remember | 3 | 3 | 1 | 10 |
| Understand | 3 | 3 | 2 | 10 |
| Apply | 3 | 3 | 2 | 10 |
| Analyse | 2 | 2 | 2 | 10 |
| Evaluate | 2 | 2 | 2 | 10 |
| Create | 2 | 2 | 1 | 10 |
| TOTAL | 15 | 15 | 10 | 60 |

## Government College of Engineering, Karad

## First Year (Sem – II) M. Tech. Mechanical- Design Engineering

## DE1206: Lab Practice - III

| Teaching Scheme | | | Examination Scheme | |
|---|---|---|---|---|
| Lectures | 04 Hrs/week | | CT – 1 | |
| Tutorials | -- | | CT – 2 | |
| Total Credits | 02 | | TA | 25 |
| | | | ESE | 25 |
| | | | Duration of ESE | Oral examination |

**Course Outcomes (CO)**

At the end of the course, the students will be able to:

| | |
|---|---|
| **1.** | create 1D & 2D FEA code for structural and heat transfer analysis |
| **2.** | create MATLAB code for parametric curves in CAD analysis |
| **3.** | create FEA model and analysis of real-life CAD models using commercial software package |
| **4.** | develop a model of plant (suspension system of car (quarter car model)) and PID control implementation |

| | Course Contents | Hours |
|---|---|---|
| **1** | Development of code of 1D & 2D structural analysis | 2 |
| **2** | Estimation of stress concentration factor of plate with central circular hole using commercial software ANSYS | 2 |
| **3** | Development of Bezier and Spline curve using MATLAB code | 2 |
| **4** | Development of MATLAB code for 2D and 3D Geometric transformation for simple geometries such as rectangle, rectangle with hole etc. | 2 |
| **5** | Design and development of modelling of suspension system using MATLAB and implementation of PID control on it for smooth control | 2 |
| **6** | FEA and Rigidity analysis of impeller in pump assembly using FEA commercial package ANSYS | 2 |
| **7** | FEA analysis of Pressure Vent Model using ANSYS | 2 |
| **8** | FEA analysis of heat transfer characteristics of pump casing | 2 |

**Text Books**


| | |
|---|---|
| **1** | P Girdhar – Machinery vibration analysis and predictive maintenance, Elsevier Newnes Publications |
| **2** | Collacot R.A.- Mechanical fault diagnosis and condition monitoring, London : Chapman and Hall |
| **3** | Rao, B. K. N. (1996), Handbook of condition monitoring, Elsevier advanced technology, Oxford |
| **4** | A Davis – Handbook of condition monitoring, London : Chapman and Hall |
| **5** | John S Mitchell – Machinery analysis and monitoring, Penn Well Publishing, Tulsa, Okla |


**Reference Books**


| | |
|---|---|
| **1** | R G Eisenmann et-al – Machinery malfunction diagnosis and correction Pearson Publication |
| **2** | Robert Bond Randall Vibration-based Condition Monitoring: Industrial, Aerospace and Automotive Applications (Google eBook) John Wiley & Sons |
| **3** | Ron Barron, Engineering condition monitoring: practice, methods and applications, Longman |
| **4** | E. D. Yardley, Condition Monitoring: Engineering the Practice, Wiley |


**Useful Links**

| | |
|---|---|
| **1.** | https://onlinecourses-archive.nptel.ac.in/noc19_me27/preview |
| **2.** | https://www.iitnoise.com/webresources.htm |
| **3.** | www.plant-maintenance.com |

## Mapping of COs and POs

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 6 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 2 | 3 | 2 | 1 | | 1 | 2 | 3 | 3 | | 3 | 3 | 3 | 2 | |
| CO 2 | 1 | | | 3 | 2 | | 3 | 3 | 2 | | | | | 3 | 3 |
| CO 3 | 3 | 3 | | 3 | | 3 | 2 | | 3 | | | 3 | 2 | | 1 |
| CO 4 | 2 | | 2 | 3 | 1 | 3 | 3 | 3 | 3 | 2 | | | | 3 | |
| CO 5 | | | 3 | | 3 | 1 | 2 | 1 | | 2 | 1 | 3 | 2 | 2 | 3 |

## Assessment Pattern(with revised Bloom's Taxonomy)

| Knowledge Level | CT 1 | CT 2 | TA | ESE |
|---|---|---|---|---|
| Remember | | | 3 | 2 |
| Understand | | | 5 | 5 |
| Apply | | | 2 | 5 |
| Analyse | | | 5 | 5 |
| Evaluate | | | 5 | 5 |
| Create | | | 5 | 3 |
| TOTAL | | | 25 | 25 |

## Government College of Engineering, Karad

## First Year (Sem – II) M. Tech. Mechanical- Design Engineering

## DE1207: Lab Practice - IV

| Teaching Scheme | | | Examination Scheme | |
|---|---|---|---|---|
| Lectures | 04 Hrs/week | | CT – 1 | 00 |
| Tutorials | -- | | CT – 2 | 00 |
| Total Credits | 03 | | TA | 25 |
| | | | ESE | 25 |
| | | | Duration of ESE | Oral Examination |

**Course Outcomes (CO)**

At the end of the course, the students will be able to:

| | |
|---|---|
| **1.** | Interface sensors (displacement, temperature, etc.) & actuators (stepper motor, DC motor, servo motors) with microcontroller with microcontroller |
| **2.** | Develop a control system and implementation on practical model |
| **3.** | Do vibration signals analysis on rotating and reciprocating system |
| **4.** | Development of product for design problem |

| | Course Contents | Hours |
|---|---|---|
| **1** | Interfacing of temperature sensor (thermocouple) with ARDUNIO and Raspberry PI and data collection in excel sheet using PLX-DAQ system | 2 |
| **2** | Interfacing of distance measurement sensor (ultrasonic) with ARDUNIO to measure a dimension of physical model | 2 |
| **3** | Interfacing of stepper motor and DC motor with ARDUNIO or Raspberry PI | 2 |
| **4** | Vibration analysis of reciprocating and rotatory machinery | 2 |
| **5** | Condition Monitoring | 2 |
| **6** | Control design and implementation of speed control of DC motor using ARDUNIO | 2 |
| **7** | Development of product for defined problem<br>Team assignments are intended to pace the development process for your product. Since there is virtually no slack in this schedule the assignments must be completed on or before the scheduled due date in order to maintain the project schedule. | 2 |
| **8** | Assignment on Industrial product design<br>Assignment: Customer Needs and Competitive Analysis Due Class<br>1. Prepare a 10-minute presentation describing the process the team used to capture the customer needs. Clearly document the customer needs determined by following the process.<br>2. The project Gantt Chart. Discuss the critical path and the team's management plan.<br>3. Develop an organized list of customer needs for your product.<br>4. Compile a list of existing products that may satisfy the customer base. Analyze the features of the competing products in relation to your identified customer needs. | 2 |

**Text Books**

| | |
|---|---|
| **1** | P Girdhar – Machinery vibration analysis and predictive maintenance, Elsevier Newnes Publications |
| **2** | Collacot R.A.- Mechanical fault diagnosis and condition monitoring, London : Chapman and Hall |
| **3** | Rao, B. K. N. (1996), Handbook of condition monitoring, Elsevier advanced technology, Oxford |
| **4** | A Davis – Handbook of condition monitoring, London : Chapman and Hall |
| **5** | John S Mitchell – Machinery analysis and monitoring, Penn Well Publishing, Tulsa, Okla |

**Reference Books**

| | |
|---|---|
| **1** | R G Eisenmann et-al – Machinery malfunction diagnosis and correction Pearson Publication |
| **2** | Robert Bond Randall Vibration-based Condition Monitoring: Industrial, Aerospace and Automotive Applications (Google eBook) John Wiley & Sons |
| **3** | Ron Barron, Engineering condition monitoring: practice, methods and applications, Longman |

| | | | |
|---|---|---|---|
| **4** | E. D. Yardley, Condition Monitoring: Engineering the Practice, Wiley | | |
| **Useful Links** | | | |
| **1.** | https://onlinecourses-archive.nptel.ac.in/noc19_me27/preview | | |
| **2.** | https://www.iitnoise.com/webresources.htm | | |
| **3.** | www.plant-maintenance.com | | |

## Mapping of COs and POs

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 6 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 2 | 1 | 1 | 2 | | 2 | 3 | 1 | 1 | 2 | 1 | 1 | 3 | 1 | 2 |
| CO 2 | 3 | 2 | 2 | 3 | | | 3 | | 1 | | 1 | | | 2 | 3 |
| CO 3 | 2 | 3 | | | 1 | 3 | | 1 | | 2 | 3 | 3 | 1 | | |
| CO 4 | 2 | | | 3 | 2 | 3 | 2 | 1 | | 2 | | 2 | | 2 | 2 |
| CO 5 | | | 1 | | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 |

## Assessment Pattern (with revised Bloom's Taxonomy)

| Knowledge Level | CT 1 | CT 2 | TA | ESE |
|---|---|---|---|---|
| Remember | | | 3 | 2 |
| Understand | | | 5 | 5 |
| Apply | | | 2 | 5 |
| Analyse | | | 5 | 5 |
| Evaluate | | | 5 | 5 |
| Create | | | 5 | 3 |
| TOTAL | | | 25 | 25 |

## Government College of Engineering, Karad

## First Year (Sem – II) M. Tech. Mechanical-Design Engineering

## PE 1208: Seminar on Pre-dissertation Work

| Teaching Scheme | | | Examination Scheme | |
|---|---|---|---|---|
| Lectures | -- | | CT – 1 | -- |
| Practicals | 04 Hrs/week | | CT – 2 | -- |
| Total Credits | 02 | | TA | 50 |
| | | | ESE | 50 |
| | | | Duration of ESE | 02 Hrs 30 Min |

**Course Outcomes (CO)**

At the end of the course the students will be

| | |
|---|---|
| **1.** | exposed to self-learning various topics. |
| **2.** | learn to survey the literature such as books, national/international refereed journals and contact resource persons for the selected topic of research. |
| **3.** | learn to write technical reports |

| | Course Contents | Hours |
|---|---|---|
| | Seminar – It should be based on the literature survey on any topic relevant to manufacturing engineering and management. It may be leading to selection of a suitable topic of dissertation.<br>Each student has to prepare a write up of about 25 pages. The report typed on A4 sized sheets and bound in necessary format should be submitted after approved by the guide and endorsement of Head of Department.<br>The student has to deliver a similar talk in front of the faculty of the department and the students. The guide based on the quality of work and preparation and understanding of the candidate shall do assessment of the seminar. | |
| | **List of Submission**<br>Seminar Report | |
| | | |

## Government College of Engineering, Karad

## First Year (Sem – I) M. Tech. Mechanical- Design Engineering

## AU1219: Constitution of India (Audit Course – II)

| Teaching Scheme | | | Examination Scheme | |
|---|---|---|---|---|
| Lectures | 02 Hrs/week | | CT – 1 | -- |
| Tutorials | - | | CT – 2 | -- |
| Total Credits | 00 | | TA | -- |
| | | | ESE | -- |
| | | | Duration of ESE | -- |

**Course Outcomes (CO)**

At the end of the course, the students will be able to

| | |
|---|---|
| **1.** | Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics. |
| **2.** | Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India. |
| **3.** | Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution. |
| **4.** | Discuss the passage of the Hindu Code Bill of 1956. |

| | Course Contents | Hours |
|---|---|---|
| **Unit 1** | **History of Making of the Indian Constitution**<br>History Drafting Committee, (Composition & Working) | **(04)** |
| **Unit 2** | **Philosophy of the Indian Constitution**<br>Preamble Salient Features | **(04)** |
| **Unit 3** | **Contours of Constitutional Rights & Duties**<br>Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties. | **(04)** |
| **Unit 4** | **Organs of Governance**<br>Parliament, Composition, Qualifications and Disqualifications, Powers and Functions<br>Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions | **(04)** |
| **Unit 5** | **Local Administration**<br>District's Administration head: Role and Importance,<br>Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation.<br>Pachayati raj: Introduction, PRI: Zila Pachayat, Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy | **(04)** |
| **Unit 6** | **Election Commission**<br>Election Commission: Role and Functioning.<br>Chief Election Commissioner and Election Commissioners.<br>State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women | **(04)** |

**Text Books**


| | |
|---|---|
| **1.** | The Constitution of India, 1950 (Bare Act), Government Publication. |
| **2.** | Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015. |
| **3.** | M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014 |
| **4.** | D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015. |

## Government College of Engineering, Karad

## First Year (Sem – I) M. Tech. Mechanical- Design Engineering

## AU1229: Pedagogy Studies (Audit Course – II)

| Teaching Scheme | | | Examination Scheme | |
|---|---|---|---|---|
| Lectures | 02 Hrs/week | | CT – 1 | -- |
| Tutorials | - | | CT – 2 | -- |
| Total Credits | 00 | | TA | -- |
| | | | ESE | -- |
| | | | Duration of ESE | -- |

**Course Outcomes (CO)**

At the end of the course, the students will be able to understand

| | |
|---|---|
| **1.** | What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries? |
| **2.** | What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners? |
| **3.** | How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? |

| | Course Contents | Hours |
|---|---|---|
| **Unit 1** | **Introduction and Methodology**<br>Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum, Teacher education, Conceptual framework, Research questions, Overview of methodology and Searching. | **(04)** |
| **Unit 2** | **Thematic overview**<br>Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries.<br>Curriculum, Teacher education. | **(02)** |
| **Unit 3** | **Evidence on the effectiveness of pedagogical practices**, Methodology for the in-depth stage: quality assessment of included studies,<br>How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?<br>Theory of change, Strength and nature of the body of evidence for effective pedagogical practices, Pedagogic theory and pedagogical approaches, Teachers' attitudes and beliefs and Pedagogic strategies. | **(04)** |
| **Unit 4** | **Professional development**<br>Alignment with classroom practices and follow-up support, Peer support, Support from the head teacher and the community, Curriculum and assessment.<br>Barriers to learning: limited resources and large class sizes | **(04)** |
| **Unit 5** | **Research gaps and future directions**<br>Research design, Contexts 2 Model Curriculum of Engineering & Technology PG Courses [Volume-I] [46], Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact. | **(04)** |

**Text Books**


| | |
|---|---|
| **1.** | Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261. |
| **2.** | Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379. |
| **3.** | Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID. |


**Reference Books**

| | |
|---|---|
| | Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282 |
| | Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell. |
| | Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign. |
| **Useful links** | |
| | www.pratham.org/images/resource%20working%20paper%202.pdf |

## Government College of Engineering, Karad

## Second Year (Sem – I) M. Tech. Mechanical- Design Engineering

## DE 1301: Dissertation Phase- I

| Teaching Scheme | | | Examination Scheme | |
|---|---|---|---|---|
| Lectures | -- | | CT – 1 | |
| Practicals | 20 Hrs/week | | CT – 2 | |
| Total Credits | 7 | | CA | 100 |
| | | | ESE | 100 |
| | | | | |

**Course Outcomes (CO)**

At the end of the course the students will be

| | |
|---|---|
| **1.** | Exposed to self-learning various topics. |
| **2.** | able to learn to survey the literature such as books, national/international refereed journals and contact resource persons for the selected topic of research. |
| **3.** | able to learn to write technical reports |
| **4.** | able to develop oral and written communication skills to present and defend their work in front of technically qualified audience. |
| | |

The dissertation work to be carried out individually commences in the Semester III and extends through Semester IV. The topic of dissertation work should be related to the areas of Design/ Mechanical Engineering Applications. Applications of computer as a tool for conceptualization, design, analysis, optimization, manufacturing, manufacturing planning/management, quality engineering, simulation of products / processes / mechanisms / systems, experimental study, etc. are to be encouraged and preferred.

**SYNOPSIS APPROVAL**

**The Head of the Department shall appoint a committee comprising of the Guide and two experts to review and approve the synopses.**

| | Course Contents | Hours |
|---|---|---|
| | It shall include the problem definition, literature survey, approaches for handling the problem, finalizing the methodology for the dissertation work and design calculations / experimental design etc. A report of the work shall be submitted at the end of Semester III after approval by the Guide and endorsement of the Head of Department. It will be assessed for term work, by the evaluation committee (*) appointed by the Head of the Department, for appropriateness, sufficiency of contents and offer suggestions if any. | |
| | (*) Note: The evaluation committee shall consist of the Guide, one senior expert faculty member and the Head of the Department or his/her representative.<br>The term work under this submitted by the student shall include.<br>1) Work diary maintained by the student and countersigned by his guide/ industrial guide.<br>2) The content of work diary shall reflect the efforts taken by candidates for (a) Searching the suitable project work and literature review<br>(b) Visits to different factories or organizations.<br>(c) The brief report of feasibility studies carried to come to final conclusion.<br>(d) Rough / free hand sketches/ drawing.<br>(e) Design calculations carried by the student.<br>The student has to make a presentation before departmental committee comprising proposed title, literature review, research gape/ objectives, research plan and expected outcome. It is expected to complete minimum 40 % research work. Evaluation of Dissertation- I will be made as per rubrics | |
| | **List of Submission**<br>Project/Dissertation Report | |

## Mapping of COs and POs

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 6 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 2 | 1 | 1 | 2 | | 2 | 3 | 1 | 1 | 2 | 1 | 1 | 3 | 1 | 2 |
| CO 2 | 3 | 2 | 2 | 3 | | | 3 | | 1 | | 1 | | | 2 | 3 |
| CO 3 | 2 | 3 | | | 1 | 3 | | 1 | | 2 | 3 | 3 | 1 | | |
| CO 4 | 2 | | | 3 | 2 | 3 | 2 | 1 | | 2 | | 2 | | 2 | 2 |

## Assessment Pattern (with revised Bloom's Taxonomy)

| Knowledge Level | CT 1 | CT 2 | CA | ESE |
|---|---|---|---|---|
| Remember | | | 15 | 15 |
| Understand | | | 15 | 15 |
| Apply | | | 10 | 20 |
| Analyse | | | 20 | 10 |
| Evaluate | | | 20 | 20 |
| Create | | | 20 | 20 |
| TOTAL | | | 100 | 100 |

| Government College of Engineering, Karad | | | | |
|---|---|---|---|---|
| Second Year (Sem – I) M. Tech. Mechanical-Design Engineering | | | | |
| PE 1302: MOOC online course | | | | |
| **Teaching Scheme** | | | **Examination Scheme** | |
| Lectures | -- | | - | |
| Practicals | - | | - | |
| Total Credits | 03 | | | |
| | | | | |
| | | | | |

Online courses available on digital platform like Moocs/ NPTEL/ Coursera etc., during the academic semester will be reviewed and listed by departmental faculty board before start of every semester. Suitable course for registered candidate will be recommended by seminar / dissertation guide and programme head considering skill sets and knowledge required for dissertation work of the individual candidate from the list. It shall have minimum 8-12 hrs duration, peer graded assignment and examination to award grade by online course offering agency. It will be approved by Dean (academic) case to case.

In case online course is not available, departmental committee will specially design syllabus for course under self-learning mode and guide will conduct end semester examination to award the grade.

## Government College of Engineering, Karad

## Second Year (Sem – II) M. Tech. Mechanical- Design Engineering

## DE 1401: Dissertation Phase -II

| Teaching Scheme | | | Examination Scheme | |
|---|---|---|---|---|
| Lectures | | | CT – 1 | |
| Practicals | 32 Hrs/week | | CT – 2 | |
| Total Credits | 16 | | CA | 100 |
| | | | ESE | 200 |
| | | | | |

**Course Outcomes (CO)**

At the end of the course the students will be able to

| | |
|---|---|
| **1.** | design and develop an experimental set up/ equipment/test rig. |
| **2.** | conduct tests on existing set ups/ Equipment and draw logical conclusions from the results after analyzing them. |
| **3.** | either work in a research environment or in an industrial environment. |
| **4.** | conversant with technical report writing. |
| **5.** | present and convince their topic of study to the engineering community. |

| | Course Contents | Hours |
|---|---|---|
| | The candidate shall submit the detailed report as per the synopsis approved by the university, of the dissertation work in the prescribed format after approval by the Guide and endorsement by the Head of the Department. It will be assessed for term work by the evaluation committee appointed by the Head of the Department, for completion of the proposed work. | |
| | (*) Note: The evaluation committee shall consist of the Guide, one senior expert faculty member and the Head of the Department or his/her representative.<br><br>The dissertation submitted by the student on topic already approved by institute authorities on basis of initial synopsis submitted by the candidate, shall be according to following guide lines.<br>Format of dissertation report:<br>The dissertation work report shall be typed on A4 size bond paper. The total number of minimum pages shall not be less than 60. Figures, graphs, annexure etc be as per the requirement.<br>The report should be written in the standard format.<br>1. Title sheet<br>2. Certificate<br>3. Acknowledgement<br>4. List of figures, Photographs/Graphs/Tables<br>5. Abbreviations.<br>6. Abstract<br>7. Contents.<br>8. Text with usual scheme of chapters.<br>9. Discussion of the results and conclusions<br>Bibliography (the source of illustrative matter be acknowledged clearly at appropriate place IEEE/ASME/Elsevier Format)<br>Deviation of work from approved synopsis is not permitted.<br>Evaluation of Dissertation- II will be made as per rubrics. Dissertation completion certificate from sponsoring industry is necessary.<br>Acceptance letter/ published one research paper in quality journal/ conference is essential. | |
| | **List of Submission**<br>Project/Dissertation Report | |
| | | |

## Mapping of COs and POs

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 6 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 2 | 1 | 1 | 2 | | 2 | 3 | 1 | 1 | 2 | 1 | 1 | 3 | 1 | 2 |
| CO 2 | 3 | 2 | 2 | 3 | | | 3 | | 1 | | 1 | | | 2 | 3 |
| CO 3 | 2 | 3 | | | 1 | 3 | | 1 | | 2 | 3 | 3 | 1 | | |
| CO 4 | 2 | | | 3 | 2 | 3 | 2 | 1 | | 2 | | 2 | | 2 | 2 |

## Assessment Pattern **(with revised Bloom's Taxonomy)**

| Knowledge Level | CT 1 | CT 2 | CA | ESE |
|---|---|---|---|---|
| Remember | | | 15 | 30 |
| Understand | | | 15 | 30 |
| Apply | | | 10 | 40 |
| Analyse | | | 20 | 20 |
| Evaluate | | | 20 | 40 |
| Create | | | 20 | 40 |
| TOTAL | | | 100 | 200 |